FIRST FIVE-YEAR REVIEW REPORT

FOR
APACHE POWDER
SUPERFUND SITE
COCHISE COUNTY, ARIZONA

September 2002

Prepared for
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U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, California 94105

Approved by:

Date:

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Deborah Jordan, Ph.D.
Chief, Federal Facility and Site Cleanup Branch
U.S. EPA, Region IX

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List of Acronyms

ACM	Asbestos Containing Material
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ADWR	Arizona Department of Water Resources
af	acre-feet
AMA	Active Management Area
ANA	Aerobic Nitrification Area
ANP	Apache Nitrogen Products, Inc.
AOP	Ammonium Oxidation Plant
APC	Apache Powder Company
APP	Aquifer Protection Permit
ARARs	Applicable or Relevant and Appropriate Requirements
AWQS	Aquifer Water Quality Standard
BADCT	Best Available Demonstrated Control Technology
BLM	U.S. Bureau of Land Management
bls	below land surface
BTEX	benzene, toluene, ethylbenzene, xylene
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chemicals of concern
DIA	Discharge Impact Area
DNB	dinitrobenzene
DNT	dinitrotoluene
ECDC	East Carbon Development Corporation
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences

FDA	Final Denitrification Area
FS	Feasibility Study
ft^2	square feet
GPL	Groundwater Protection Level
gpm	gallons per minute
H+A	Hargis + Associates, Inc.
HBGL	Health-based Guidance Level
LAN	liquid ammonium nitrate
LCU	laterally-confining unit
LUST	leaking underground storage tank
MCA	Molinos Creek sub-Aquifer
MCL	Maximum Contaminant Level
µ/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MNA	monitored natural attenuation
NARS	Northern Area Remediation System
NPL	National Priority List
O&M	operation and maintenance
OBOD	Open Burn/Open Detonation
PCB	polychlorinated biphenyl
PDA	Primary Denitrification Area
PETN	pentaerythritol tetranitrate
ppb	parts per billion
RCRA	Resource Conservation and Recovery Act
RDI	remedial design investigation
RI	Remedial Investigation
ROD	Record of Decision
SA & B	SA & B Environmental and Chemical Consultants

SDWA	Safe Drinking Water Act
SLERA	Screening-Level Ecological Risk Assessment
SPA	San Pedro Aquifer
SPLP	synthetic precipitation leaching procedure
SRL	soil remediation level
SVOC	semivolatile organic compound
TBC	to be considered
TCL	Target Compound List
TNB	trinitrobenzene
TNT	trinitrotoluene
TOSA	Temporary On-site Storage Area
TPH	Total Petroleum Hydrocarbons
UAN	Urea Ammonium Nitrate
UAO	Unilateral Administrative Order
UST	underground storage tank
UXO	unexploded ordnance
VOC	volatile organic compound
yd^3	cubic yard

Five-year Review Summary Form

Site name : Apache Powder Superfund Site

EPA ID: 09C6 **CERCLIS ID #:** AZD008399263

Region: IX **State:** AZ **City/County:** Benson/Cochise

NPL status: ■ Final ☐ Deleted ☐ Other (specify) ____________________

Remediation status (choose all that apply): ■ Under Construction ■ Operating ■ Complete

Multiple OUs? ■ YES ☐ NO **Construction completion date:** NARS: November 1997

For this site Operating Units are identified as Media Components

Has site been put into reuse? ☐ YES ■ NO

Reviewing agency: ■ EPA ☐ State ☐ Tribe ☐ Other Federal Agency ____________________

Author name: Andria Benner

Author title: Remedial Project Manager **Author affiliation:** EPA Region IX

Review period: April – July 2002

Date(s) of site inspection: May 8 and 10, 2002

Type of review: ■ Statutory

☐ Policy (☐ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only

☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead

☐ Regional Discretion)

Review number: ■ 1 (first) ❑ 2 (second) ❑ 3 (third) ❑ Other (specify)
Triggering action: ❑ Actual RA Operation of Groundwater Remedial Systems   ■ Actual RA Start at OU# NARS (Media Component 2A) ❑ Construction Completion   ❑ Previous Five-year Review Report ❑ Other (specify) ______
Triggering action date: May 1997
Due date (five years after triggering action date): 2002

Executive Summary

A five-year review of the Apache Powder Superfund Site (the Site) in Cochise County, Arizona was completed in September 2002. The five-year review was required by statute and undertaken because hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unrestricted use and unlimited exposure. The triggering action for this review was the construction in 1997 of the wetlands system, known as the Northern Area Remediation Systems (NARS), to treat the nitrate-contaminated shallow aquifer groundwater plume in the northern area. Although other actions were taken at the Site prior to construction of the NARS, including but not limited to a removal action of contaminated drums and installation of replacement deep aquifer drinking water wells, the wetlands construction has been identified by United States Environmental Protection Agency (EPA) as the first completed remedial action event, as required by the 1994 EPA Unilateral Administrative Order (UAO) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In addition, to actions taken under EPA's UAO, other cleanup activities have been conducted at the Site under a separate State Consent Decree (CD) issued in 1994 by the Arizona Department of Environmental Quality (ADEQ). This is the first five-year review for this site.

Historically, explosives were manufactured at the Site and wastewater was discharged to unlined ponds and tributary washes. The Site is bordered by the San Pedro River to the east. Eight areas of concern have been identified at the Site: seven media components and one Removal Action.

- Media Component 1: Perched Groundwater Aquifer
- Media Component 2A: Northern Area Shallow Groundwater Aquifer
- Media Component 2B: Southern Area Shallow Groundwater Aquifer
- Media Component 3: Inactive Ponds 4A, 4B, 5A, 5B, 6A, 6B, 7, 8; and Dynagel Pond
- Media Component 4: White Waste and Drum Storage Area
- Media Component 5: Wash 3 Area (Excluding the Open Burn/Open Detonation [OBOD] Area)
- Media Component 7: Drums located outside of Wash 3 Area
- Removal Action: Trinitrotoluene (TNT) Contaminated Area

The September 1994 Record of Decision (ROD) for the Site required implementation of remedial actions for five media components:

- Use of a brine concentrator (forced evaporation) to treat plant process wastewaters for total dissolved solids, including nitrate, fluoride, and arsenic, prior to reuse.

- Use of constructed wetlands (biological treatment) to treat the nitrate-contaminated shallow aquifer.
- On-site containment (capping) of contaminated soils in the "Inactive Ponds."
- Excavation and off-site treatment and disposal of contaminated soils (arsenic and dinitrotoluene [DNT]) from the White Waste Material and Drum Storage Area.
- Excavation and off-site treatment and disposal of the lead and DNT contaminated soils from the Wash 3 Area.

The ROD has been modified twice. In 1996, as a result of new data gathered at the Site, EPA signed an Explanation of Significant Differences (ESD) #1 allowing Apache Nitrogen Products, Inc. (ANP) to treat the perched groundwater in the southern area in a constructed wetlands system separate from the system to be constructed in the northern area for the nitrate-contaminated shallow aquifer.

In September 2000, EPA completed ESD #2 that modified soil clean-up levels outlined in the 1994 ROD. The ROD recommended capping ponds as a remedy but did not specify standard clean-up levels. ESD #2 established cleanup standards for:

- Inactive Pond soils and sediments (Media Component 3).
- White Waste Materials and Drum Storage Area (Media Component 4).
- Wash 3 Area (Media Component 5).
- Other Drums (Media Component 7).

ESD #2 also allowed for "No Further Action" for selected soils media components where hazardous substances were not detected or levels of contaminants do not exceed EPA selected cleanup standards.

This five-year review evaluated the aforementioned remedial actions to ascertain whether they remain protective of human health and the environment as originally intended by the ROD. The five-year review process consisted of a regulatory review, a document review, and a site inspection.

The results of the five-year review indicate that the remedies for Media Components 4, 5, 7, and 8, the vadose zone remedy, have remained protective of human health and the environment. However, a protectiveness determination of the remedy cannot be made at this time for Media Components 1, 2, and 3.

A treatment wetlands was not constructed for the perched groundwater aquifer or the southern shallow aquifer due to the discovery of perchlorate contamination and the possible ecological risks. Currently, monitored natural attenuation (MNA) is under consideration as a remedy for

Media Components 1 and 2B. The primary data gap that would make effectiveness of MNA questionable is that, to date, lithologic data have not been collected to confirm the presence of a laterally-confining unit (LCU) creating hydraulic isolation in this location. Installation of borings in this area is scheduled for September 2002 to fill this data gap.

Despite delayed full scale startup of the NARS, the northern area nitrate-N plume has decreased in size. After completing construction, planting and establishment of the wetlands vegetation, and initial startup testing in 1998-2000, initial startup testing began in the summer of 2001. During the summer of 2002, various engineering changes were made on the circulation system and tests were conducted on alternative carbon sources, with limited success for certain carbon sources. It is anticipated that by the summer of 2003, the NARS should be functioning effectively and meeting discharge standards so that full-scale treatment and discharge can begin.

Based on additional soil characterization testing and evaluation of the beneficial surface water management of the Inactive Ponds (Media Component 3), the ROD selected remedy of capping the ponds has not yet been implemented. A final decision as to whether further remedial action is necessary will be ~~may~~ made by EPA once a Screening-Level Ecological Risk Assessment (SLERA) is completed, anticipated to be by the end of 2002.

The schedules for completion of each of these outstanding Media Components (1, 2, and 3) have not been completely developed. Once outstanding data gaps are filled and EPA has amended the remedy decision documents, the final remedies may be implemented and operated. At that time, each of these outstanding media components will need to be reviewed for protectiveness.

Five-year Review Report
Apache Powder Superfund Site
Cochise County, Arizona

1.0 Introduction

The EPA has conducted a five-year review of the remedial actions implemented at the Apache Powder Superfund Site (the Site), in Cochise County, Arizona (Figure 1). To assist the EPA, CH2M HILL has prepared this report, which documents the results of the five-year review.

The purpose of the five-year review process is to evaluate whether the remedy at the Site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in five-year review reports. In addition, five-year review reports identify any deficiencies found during the review and provide recommendations for addressing them.

This review is required by Federal statute. EPA must implement five-year reviews consistent with CERCLA. CERCLA Section 121(c), as amended, states:

> If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the Site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented.

Consequently, this Five-year Review Report has been completed because hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unrestricted use and unlimited exposure.

This is the first Five-year Review Report for the Apache Powder Superfund Site. The triggering action for this review was the construction of the NARS in May 1997. This report covers eight areas of concern that have been identified at the Site: seven media component areas, and one area where removal action was taken.

- Media Component 1: Perched Groundwater Zone
- Media Component 2A: Northern Area Shallow Groundwater Aquifer
- Media Component 2B: Southern Area Shallow Groundwater Aquifer
- Media Component 3: Inactive Ponds 4A, 4B, 5A, 5B, 6A, 6B, 7, 8; and Dynagel Pond
- Media Component 4: White Waste Materials and Drum Storage Area
- Media Component 5: Wash 3 Area (Excluding OBOD Area)
- Media Component 7: Drums located outside of Wash 3 Area
- Removal Action: TNT-contaminated Area

Media Component 6 is not discussed in this review because it does not identify a specific contaminated area of concern, but instead required additional investigative studies to determine the effect of groundwater pumping and the feasibility of irrigation as a potential remedial alternative for the southern area shallow aquifer. This task was established in response to concerns raised by the agricultural community about a potential evaporation loss of water from the proposed wetlands and community interest in potential irrigation alternatives. However, when perchlorate was discovered at the Site in 1998, irrigation was no longer considered a viable cleanup option.

2.0 Site Chronology

Table 2-1 provides a chronology of events at the Site.

Table 2-1: Chronology of Site Events

Event	**Date**
Apache Powder Company (APC) began manufacturing industrial chemicals and explosives at the Site.	1922
APC discharged facility wastewater to dry washes that discharged into San Pedro River.	1922 to 1971
Dye Carbonics operated a carbon dioxide plant at the Site.	1973 to 1979
APC discharged facility wastewater into unlined evaporation ponds.	1971 to 1995
Arizona Department of Health Services (ADHS) identifies the Site as a potential problem.	1979
The Site was proposed for listing on National Priority List (NPL).	1986
Preliminary investigation performed; San Pedro River hot-spot identified	1987
EPA issued special Notice Letter to APC notifying it of its liability and offering the opportunity to conduct a remedial investigation/feasibility study (RI/FS).	1988
EPA issued a UAO for RI/FS.	1989
Bottled water supplied to residents with nitrate-contaminated wells.	1989
Site listed on NPL.	1990
APC became ANP.	April 1990
EPA assumed federal lead.	1993
EPA directed ANP to remove approximately 262 drums containing DNT and approximately 60 cubic yards of DNT–contaminated soils from Wash 3, where they were stored in a temporary on-site storage area (TOSA)	1993
Draft RI/FS report completed by ANP	1994

Table 2-1: Chronology of Site Events	
Event	**Date**
EPA assumed federal lead to complete FS	June 1994
ADEQ and ANP signed State CD to bring ANP into compliance with state air regulations, Resource Conservation and Recovery Act (RCRA) hazardous waste requirements, and aquifer protection permit (APP) requirements.	June 1994
Record of Decision (ROD) signed.	September 1994
Eight deep aquifer replacement wells completed for households using bottled water.	October 1994
UAO issued for cleanup of groundwater and soils.	December 1994
State CD became effective	November 1994
EPA UAO issued for RD/RA for groundwater and soils; brine concentrator completed.	December 1994
ANP agreed to implement EPA RD/RA UAO and assumed lead	January 1995
Brine concentrator start-up testing began.	February - March 1995
Full scale start-up of brine concentrator to treat wastewater; wastewater no longer discharged to unlined ponds.	April 1995
Explanation of Significant Differences (ESD) #1 issued to allow treatment of the perched aquifer with the southern shallow aquifer in a southern area wetlands, additional well installation, and soil characterization, treatment and removal.	1996
Northern Area Remediation System (NARS) constructed.	1997
State CD closed OBOD Area.	March 1997
TNT-contaminated area discovered.	August 1997
NARS in establishment phase.	1998 to 2001
Unexploded ordnance (UXO) survey completed.	February 1999
Perchlorate investigation completed; detected in perched and shallow aquifer and shallow soils.	November 1998
Time-critical Removal Action Memorandum for removal of TNT-contaminated soil issued under the UAO, 'Other Response Actions' and 'Endangerment and Emergency Response' sections.	November 1999

Table 2-1: Chronology of Site Events	
Event	**Date**
TNT preburn performed.	December 1999
Media Components 4 (White Waste Materials and Drum Storage Area), 5 (Wash 3 Area), and 7 (Drums located outside Wash 3 Area) remediated (contaminated soils removed), and TNT-contaminated soils removed.	January 2000 to June 2000
Removal Action Implementation Reports issued for TNT-contaminated area and Media Components 4, 5, and 7.	August 2000
ESD #2 issued to establish clean up standards for chemicals of concern (COC) in soil recently detected or not mandated in the ROD; and modified soil cleanup remedies to 'No Further Action' where concentrations were non-hazardous or less than State of Arizona SRLs. (EPA clean-up standards).	September 2000
Remediation Implementation Report issued for Media Component 3 (Inactive Ponds 4A, 4B, 5A, 5B, 6A, 6B, 7, 8, and Dynagel Pond).	February 2001
ANP completes *Draft Characterization of Groundwater Systems in the Southern Area* Report	April 2001
Draft Monitored Natural Attenuation Report, and Supplemental FS submitted; Nitrate hot-spot rediscovered in San Pedro River; NARS start-up testing commenced for the season.	June 2001
ANP conducted San Pedro River water quality follow-up sampling.	October 2001
NARS start-up testing commenced for the season.	June 2002
EPA conducted follow-up San Pedro water quality sampling.	July 2002
Phase II investigation scheduled to fill in data gaps related to lateral confining unit (LCU) in southern area shallow aquifer and source of nitrate hot-spot in northern area on San Pedro River.	September 2002

3.0 Site Background

The Apache Powder Superfund Site is an area of approximately 9 square miles located in Cochise County, approximately 7 miles southeast of Benson, Arizona (Figures 1 and 3). The Site comprises approximately 1,000 acres of land and is located in a portion of Section 12, Township 18 South, Range 20 East (T18S/R20E) and portions of Sections 6, 7, and 8 in T18S/R21E. The San Pedro River flows along the eastern portion of the Site from the southeast corner of the ANP property north towards the northwest. The study area referred to herein extends approximately 0.5 mile east to over 3 miles northwest beyond ANP property boundaries. The predominant topography is "badlands," characterized by eroded ridges and hummocks incised by northeast-trending washes.

Major land uses within the vicinity of the industrial site include low-density residential, riparian, and desert scrub vegetation and agricultural. The San Pedro Riparian National Conservation Area, owned and operated by the U.S. Bureau of Land Management (BLM), is located approximately 1 mile south of the Site along the San Pedro River.

3.1 Overview of Physical Site Characterization

3.1.1 Physiography

The Site is located in the Upper San Pedro River Basin (the Basin) in the Basin and Range physiographic province. This physiographic province is typified by broad, gently-sloping, alluvial basins separated by north- to northwest-trending block fault mountains. The Upper San Pedro River Basin ranges from 15 to 35 miles wide and trends north-northwest. The basin is bounded by several mountain ranges including the Whetstone Mountains to the west, Dragoon Mountains to the east, Huachuca Mountains to the southwest, and Mule Mountains to the southeast (Hargis + Associates, Inc. 2001).

3.1.2 Drainage

The San Pedro River is the dominant drainage feature in the Basin. The drainage area of the Upper San Pedro River Basin is approximately 2,500 square miles, of which 700 square miles are in Mexico. The river flows north and joins the Gila River near Winkelman, Arizona. Flow in the San Pedro River is perennial where the streambed intercepts the water table. One large perennial reach extends north of Hereford to a point just south of Fairbank. The major tributary to the San Pedro River is the Babocomari River which joins the San Pedro River approximately 14 miles south of the Site. Several minor tributaries also contribute to the San Pedro River. Near the Site, the San Pedro River meanders in a channel between 150 and 200 feet wide. Flow in the channel is generally restricted to less than 20 percent of the bank-to-bank width. During baseflow periods, the river depth ranges between 0.5 to 2 feet. Ephermal washes have been eroded generally perpendicular to the San Pedro River across the site from the western uplands (Hargis + Associates, Inc. 2001a).

3.1.3 Climate

The climate at the Site is characterized as semiarid with long, hot summers and relatively short, cool winters. Minimum temperatures generally occur in December and January with the maximum during July and August. Mid-summer daily maximum temperatures routinely exceed 100°F.

The average annual precipitation at the Site is 13.41 inches, based on climatological observations recorded between 1951 and 1980. Approximately 60 percent of the total annual precipitation usually falls between July and mid-September. During this period, afternoon thunderstorms form over the nearby mountains and produce moderate to heavy rainstorms, referred to as the "monsoon season." Approximately 70 percent of the total annual discharge of the San Pedro River occurs during the months of July through September. The secondary period of maximum precipitation occurs between December and February as the result of mid-latitude storms traveling to the east from the Pacific Ocean. Approximately 20 percent of the total annual precipitation falls during this period (Hargis + Associates, Inc. 2001a). Only a very small percentage of precipitation falls as snow.

3.1.4 Regional Geology / Hydrogeology

The Upper San Pedro River Basin is a deep alluvial-filled structural basin created by downdrop of the valley floor and uplift of the surrounding mountain ranges. The thickness of the alluvial sediments is unknown but is thought to be greater than 1,000 feet near the center of the basin, thinning to a veneer along the mountain fronts. The alluvial fill sediments are Late Cenozoic Age and are derived from the igneous, metamorphic, and sedimentary rocks that form the mountain ranges bounding the Basin. The thickest of the late Cenozoic sequence is the St. David Formation, primarily comprising of silt and clay with some fine sand, fresh limestone, and water-lain pyroclastic materials. The St. David Formation generally coarsens upward within the study area (Hargis + Associates, Inc. 2001a).

The regional hydrogeology of the Upper San Pedro River Basin near the towns of St. David and Benson has been studied in detail. Groundwater occurs in the alluvium along the San Pedro River and its tributaries. The lithologic units comprise a single hydrostratigraphic unit that forms a water table aquifer, referred to as the "shallow aquifer." The lithology of the shallow aquifer consists primarily of gravel, sand, and silt deposits. These deposits are generally between 40 and 100 feet thick but locally may be as thick as 150 feet. These deposits are unconsolidated and relatively permeable and yield as much as 2,000 gallons per minute (gpm) to properly constructed wells. (Hargis + Associates, Inc. 2001a).

Groundwater also occurs in the lower portion of the St. David Formation and the underlying older sedimentary rock layers. These lithologic units comprise a single hydrostratigraphic unit, referred to as the "deep aquifer." The deep aquifer comprises two distinct units referred to as the upper unit and lower unit. The upper unit of the regional deep aquifer consists of clayey and silty gravel beds near the mountains and clay, silt, and sandy silt with interbeds of gypsum in the central part of the San Pedro River Valley. The upper unit of the regional deep aquifer ranges from 300 to 800 feet in thickness. The lower unit of the regional deep aquifer is comprised of older sedimentary rocks including lenses of gravel, sandstone, and siltstone. Gypsiferous silt lake beds may also be present. The lower unit of the deep regional aquifer is encountered at depths greater than 600 feet bls in the study area, and ranges in thickness from several tens of feet near the edge of the valley to more than 1,000 feet beneath the San Pedro River (Hargis + Associates, Inc. 2001a).

Groundwater in the upper unit of the deep aquifer in the study area is confined by an aquitard consisting of the overlying silt and clay and silt sediments of the upper portion of the St. David Formation. The thick beds of clay and silt in the upper St. David Formation are referred to as the St. David Clay and separate the deep aquifer from the shallow aquifer (Hargis + Associates, Inc. 2001a).

Water levels in wells that penetrate the regional deep aquifer east of the San Pedro River rise above the overlying St. David clay, exhibiting artesian conditions. Flowing wells have been observed near the town of St. David. These flowing wells indicate that the hydraulic head of this aquifer is greater than the hydraulic head in the overlying shallow aquifer. If leakage through the St. David clay occurred, it would be upward from the deep aquifer to the upper unconfined aquifer (Hargis + Associates, Inc. 2001a).

3.1.5 Site Geology / Hydrogeology

In addition to the regional features mentioned, site-specific geologic and hydrogeologic features are present that influence contaminant transport and flow. The hydrogeology of the southern area of the site was recently studied in detail. Following deposition of the St. David Clay, three paleochannels were formed including a broad, relatively shallow trough underlying the perched zone, another along the western shallow aquifer boundary, and the final larger trough east of the San Pedro River. Respectively, these paleochannels are named "Apache Wash," "Molinos Creek," and the Ancestral San Pedro River (Figure 4) (Hargis + Associates, Inc. 2001a). East of the Molinos Creek paleochannel, a lower hydraulic permeability unit, the LCU, is currently under investigation. As a result of the low hydraulic properties of the LCU, the southern shallow aquifer has been further divided to the "Molinos Creek sub-Aquifer" (MCA) and the "San Pedro Aquifer" (SPA) (Hargis + Associates, Inc. 2001a). The areal extent of the LCU is currently unknown.

For management purposes, within the study area the shallow groundwater aquifer is referred to as the northern and southern area based on the separation in nitrate-nitrogen plumes. In both areas there is the continuous shallow groundwater aquifer and a deep confined-groundwater aquifer. The shallow groundwater aquifer is comprised of sands, gravels and silts. Depths to groundwater in the shallow aquifer in the study area are between 20 and 80 feet below land surface (bls). A layer of St. David Clay with minimum thickness of 220 feet hydraulically divides the shallow aquifer from the deep aquifer. Near the Site, the upper unit of the regional deep aquifer is encountered at depths ranging from approximately 300 feet to 400 feet bls.

In the southern area, historical discharge practices resulted in an artificial perched zone comprising saturated alluvial materials overlying St. David Clay. The perched zone is limited to the ANP Operations Area, extending eastward to the shallow aquifer. Downward vertical migration of the perched aquifer is limited by the extremely low hydraulic permeability of the St. David Clay. Depths to perched zone groundwater range between approximately 21 and 55 feet bls. Perched groundwater is limited to the ANP property and is not extracted for use (Hargis + Associates, Inc. 2001a).

A network of groundwater monitoring wells and piezometers is present throughout the site, monitoring both the perched and shallow aquifer in the south and the shallow aquifer in the north. In addition, extraction well SEW-1 and wetlands design confirmation piezometer (DCP-1) are monitored and sampled in the north.

3.2 Land and Resource Use

A land use survey was performed as part of the remedial investigation to identify the major types of land use in the study area. The major types of land use surrounding the Site identified in the study were:

- The Chihuahuan Desert Scrub Area and Disturbed Areas: The Chihuahuan Desert Scrub Areas are those in which the typical Chihuahuan desert scrub vegetation is in its natural condition. The Disturbed Areas are areas where the natural density of Chihuahuan desert scrub vegetation has decreased due to clearing for past residential, agricultural, road building, or railroad activities. Both the Chihuahuan Desert Scrub Area and the Disturbed Areas are typically used for cattle grazing.

- Riparian Vegetation Area and Disturbed Areas: The Riparian Vegetation Areas are those areas in which the typical riparian vegetation is present in its natural condition. The Disturbed Areas are where the natural density of riparian vegetation has decreased due to clearing for past residential, agricultural, road building, or railroad activities. Range cattle and native fauna have direct access to most of the Riparian Vegetation and Disturbed Areas. The San Pedro National Conservation Area is located approximately 1 mile south of the Site.

- Low-density Residential Area: The Low-density Residential Areas are where residential dwellings are present. Typical residential lots are 5 acres or larger in size. The estimated average density of residential dwelling units is about five dwellings per square mile, based on an analysis of aerial photographs.

- Agricultural Land Area: The Agricultural Land Areas are those in which well-defined active or recently fallow agricultural fields were identified. The majority of the

Agricultural Land Areas are east of the San Pedro River. The agricultural lands are used to grow crops for direct human consumption and for fodder for domestic animals.

- Mining Area: A small, gravel-mining operation was observed in the southern portion of the study area during the land use survey (Hargis + Associates, Inc. 1994).

Study area population was estimated based on examination of aerial photographs and statistics compiled for the 1980 census. Based on an average of 2.8 people per residential unit, an estimated 170 people live in the study area. There is the potential for future expansion in the St. David/Benson community.

The Site is zoned for industrial use. Current industrial activities conducted at the ANP site include the manufacturing of nitric acid, liquid ammonium nitrate (LAN), solid ammonium nitrate (prill), and ammonium-nitrate-based fertilizers. Most manufacturing activities are conducted in the manufacturing area located in the southern portion of the ANP site (Figure 5). Vacant process buildings from previous operations are present to the north and east of the currently active process buildings. Portions of the surrounding areas are barren as a result of land use activities and are classified as disturbed vacant land.

The deep aquifer below the Site is a source of process water for ANP operations. Three production wells currently supply water for ANP. A fourth production well, ANP-2, was abandoned in 1999, pursuant to agreements with ADEQ relating to Paragraphs 36 and 37 of the State's CD. This deep aquifer is also a domestic and irrigation water source for the region.

The shallow aquifer is used as a domestic and irrigation water source for the region. The 1987 preliminary investigation identified eight wells that were impacted by nitrate from ANP. These eight wells were removed from service in 1989 and replaced with eight deep-aquifer wells in 1994.

3.3 Overview of Historical Activities at the Site

APC commenced operations in 1922. On April 1, 1990, APC became ANP. In the past, ANP manufactured nitroglycerin-based explosives, ammonia, sulfuric acid, and water gel high explosives (Dynagel). Dye Carbonics, Inc. operated a carbon dioxide plant at the Site from 1973 to 1979. Currently, ANP manufactures nitric acid, solid and LAN, blasting agents, and nitrogenous fertilizer solutions.

According to ANP, wastewater generated by the facility included condensate from nitric acid neutralization from 1947 to 1989; process blowdown from the ammonia plant from 1958 to 1979; washdown water from the prill plant from 1963 to at least 1986; nitration and nitroglycerin handling contact waters from 1922 to 1983; and noncontact cooling waters from the sulfuric acid plant from 1946 to 1965, from the acid mixing operations from 1922 to 1983, from the ammonium nitrate crystallization plant from 1922 to 1983, and from the ammonia plant from 1958 to 1979. Currently, ANP generates cooling tower and boiler blowdown, equipment washdown, condensate, and water-softening plant wastewater.

Prior to 1971, wastewater was discharged into tributary washes of the San Pedro River that drain the Site. Between 1971 and 1995, wastewater was discharged to unlined surface impoundments on site creating a perched groundwater zone. There are at least 20 surface impoundments: 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, 5B, 6A, 6B, 7, 8, 9, 9A, 9B, the Dynagel Pond, the Laundry Pond, and the Prill Wash Pond.

Nine of these ponds (4A, 4B, 5A, 5B, 6A, 6B, 7, 8, and Dynagel) are categorized as "Inactive Ponds". Of the "Inactive Ponds," most were either not used or only minimally used for industrial purposes, with the exception of Pond 7 and Dynagel. The remaining ponds (1A, 1B, 2A, 2B, 3A, 3B, 9, 9A, 9B, Laundry Pond, and Prill Wash Pond) are categorized as "Formerly Active Ponds." Most of the discharge was routed to Ponds 1A, 1B, 2A, 2B, 3A, and 3B, all located within Wash 6 watershed.

ANP also generated solid wastes, including explosive materials. These materials were burned on two pads in a designated on-site burn area, originally identified as "Ash and Burn" area, and subsequently classified as an OBOD facility, when it was permitted under RCRA. This area was used until 1997 for the incineration of waste materials from the on-site detonating cord manufacturing plant, in accordance with the requirements of the ADHS, now ADEQ, under Air Pollution Control Operating Permit Number 24112-87.

3.4 Initial Response

The Site was first identified as an environmental problem in 1979 by the ADHS during the course of a surface impoundment assessment. In 1980, high levels of some heavy metals were also found in one of the ponds on Apache Powder property. Concerned about possible groundwater contamination, the ADHS and the Southeastern Arizona Governments Organization did preliminary studies of nitrate contamination in the Apache Powder area in 1984. This testing showed high levels of nitrates in some private wells. EPA proposed the Site for listing on the NPL in 1986.

In 1987, EPA directed a preliminary investigation of the Site that was completed the following year. In 1988, EPA issued a Special Notice Letter notifying ANP of its liability and offering the company the opportunity to conduct and finance an RI/FS. In 1989, EPA issued ANP an UAO under Section 106 of CERCLA for completion of the RI/FS. As an intermediate remedial measure, ANP began supplying bottled water to nearby residents with nitrate-contaminated drinking water supply wells in 1989.

The preliminary investigation identified Wash 3 Area—a channel leading to the San Pedro River that included a drum storage area—as an area of concern. In 1989, investigations proceeded within this area that included 127 drums and seven stained soil areas.

In 1990, ANP was placed on the NPL. In 1990 and 1991, ANP completed several studies (Soils Investigation, Source Control Plan, Study Area Survey, Hydrogeological Analysis, and San Pedro River Supplemental Sampling). These studies were summarized in ANP's 1992 *Draft Remedial Investigation Report*. In addition to other COCs, this report identified nitrate-nitrogen as the primary COC with the most mobility at the site. This COC was identified in soils and pond sediments and a groundwater plume extending from the perched zone through the shallow aquifer.

In 1993, ANP completed an additional report on the Wash 3 and Drum Disposal Area investigation. This report summarized the 1991 excavation and removal of deteriorated 110-gallon steel drums, estimated at the time to be 30 to 40 years old; approximately 230 cubic feet of soil; further inventory of drums; excavation of 45 cubic yards of DNT contaminated soil; and a geophysical survey. All materials were excavated and remained on site within the Temporary On-site Storage Area (TOSA).

In June 1994, EPA issued a Proposed Plan recommending: cleanup of contaminated soils on the Site, use of a brine concentrator to treat the contaminated perched groundwater, and use of constructed wetlands to treat the nitrate-contaminated shallow aquifer groundwater. In September 1994, after a public comment period, EPA selected the proposed remedies in the Proposed Plan for the Site. Concurrently that year, EPA completed the FS report (as a federal lead document), which had been drafted by ANP, and issued a Proposed Plan for the remedy. The primary change to ANP's draft FS was EPA's introduction of a constructed wetlands alternative for cleanup of the shallow aquifer nitrate-contaminated groundwater.

During completion of the ROD in 1994, ANP had interim status under RCRA for treatment of explosive wastes in its Ash and Burn Area. The Ash and Burn Area, also known as the OBOD Area, underwent closure review by the ADEQ under its RCRA program authority. In June 1994, ANP and ADEQ signed a State CD, with an effective date of November 1994, containing a schedule for bringing ANP into compliance with state hazardous waste and APP regulations and permitting requirements. As a component of the CD, ANP agreed to construct a brine concentrator to treat the industrial process wastewater that historically had been the primary source of groundwater contamination at the Site.

3.5 Basis for Taking Action

Table 3-5 identifies contaminants of concern (hazardous substances, pollutants, and contaminants) that have been released at the Site in each media component as designated by the ROD and two ESDs. As noted in the footnotes of Table 3-5, in a few instances the identified contaminants were subsequently tested and determined to be non-hazardous materials.

Table 3-5: Estimated Quantities of Contaminated Media			
Media Component	**Chemicals of Concern**	**Area**	**Area and Volume of Contaminated Media**
1: Perched Groundwater[(a)]	Arsenic, fluoride, nitrate, and perchlorate[(d)]	South-western portion of the ANP Site; vicinity of active ponds, cooling towers, and unlined ditches in the vicinity of plant facilities	During the preliminary investigation and remediation investigation, the area of perched groundwater was estimated to be 1,344,185 square feet (ft^2). Volume was estimated to be 167 acre-feet (af) of perched groundwater.
2A and 2B: Shallow Aquifer Groundwater[(a)]	Nitrate; additionally perchlorate[(d)] in Media Component 2B	Shallow aquifer groundwater west of the San Pedro River in Section 36 in Township 17 South (T17S), Range 20 East (R20E), and Sections 6, 7, and 8 in T18S, R21E	During the preliminary investigation and remedial investigation, the total area of contaminated shallow aquifer groundwater was estimated to be 14.9 million ft^2. Volume was estimated to be 15,400 af of shallow aquifer groundwater.
San Pedro River Surface Water[(a, e)]	Nitrate	Reach of San Pedro in Section 36 in T17S, R20E, and Section 6 in T19S, R21E	Total volume not quantified
3: Inactive Ponds Soil[(a)]	Antimony, arsenic, barium, beryllium, chromium, lead, manganese, and nitrate	Dynagel Pond 4A Pond 4B Pond 5A Pond 5B Pond 6A Pond 6B Pond 7 Pond 8	Total surface area of inactive ponds estimated to be 312,000 ft^2
4: White Waste Area Soil[(a)]	Nitrate and arsenic	Southwest portion of site west of active ponds	Approximately 1,900 ft^3 or 280,000 pounds
4: Drum Storage Area[(a)]	Vanadium pentoxide, cooling tower ceramic packing material[(c)]	Southwest portion of site west of active ponds and cooling towers	Approximately 165 tons of ceramic packing materials

Table 3-5: Estimated Quantities of Contaminated Media			
Media Component	**Chemicals of Concern**	**Area**	**Area and Volume of Contaminated Media**
5: Wash 3 Area (Excluding the OBOD Area) 7: Drums[(a)]	2, 4-DNT,2,6-DNT, lead, and paraffins[(b)(c)]	Excavated and moved to TOSA from main accumulation area, drum disposal area, vicinity of Ponds 5A and 5B, north of the OBOD Area, and scattered throughout Wash 3 Area	Approximately 290 tons DNT contaminated soil and 25 tons of drums and plastic liner, additional 9 cubic feet of impacted DNT soil
Stained Soil Areas[(a, e)]	DNT, paraffins[(b)(c)]	Vicinity of the OBOD Area; vicinity of Ponds 4A, 4B, and 5A; vicinity of area west of Pond 3	Approximately 65 cubic yards (yd^3) of stained soil
7: DNT Drums Located Outside of the Wash 3 Area	2,4-DNT 2,6-DNT	Wash 5 channel near Pond 8, Drum Storage Area, and Warehouse 244; one 110-gallon drum found within White Waste Storage Area.	Fourteen 55-gallon drums of DNT contaminated soil; two 5-gallon buckets of pure DNT product; nine 55-gallon drums of DNT pure product; eight 110-gallon drums; three 55-gallon drums – one containing naphthalene; one 110-gallon drum within White Waste Area contained di-ethylene glycol.
8: Trinitrotoluene – Contaminated Area	Trinitrotoluene 2,4-DNT 2,6-DNT, and 1,3,5-Trinotrobenzene	Western Portion of ANP Site near Pond 4 and west of the active manufacturing area	Estimated 50 yd^3 of stained soil; sampling and unexploded ordinance survey will be conducted to further delineate the nature and extent of contamination

(a) COCs identified in the remedial investigation (Hargis + Associates, Inc./Bechtel 1994).
(b) Paraffins are present as a result of DNT decomposition.
(c) ESD #2 redesignated paraffins and packing material as non-hazardous waste.
(d) Perchlorate not identified until 1998 Perchlorate Investigation.
(e) Media Component identification not assigned.
Nitrate-N = nitrate-nitrogen.
DNT = dinitrotoluene.

The information on site risks is taken from the Baseline Public Health Evaluation and Ecological Assessment completed by EPA in September 1992, with additional information from the revised EPA FS report of June 1994.

The health evaluation process included: (a) identifying contaminants from historical operations that are currently present in the groundwater, surface water, soils and sediments;

(b) characterizing the population potentially exposed to these contaminants; and (c) evaluating the potential health effects from exposure to contaminated groundwater, surface water, soil and sediments. EPA evaluated how individuals might be exposed to these contaminants under both current and future conditions. Potential risks to natural resources also were evaluated.

The primary human health risk posed by the Site is the potential for direct ingestion of shallow aquifer groundwater contaminated by nitrate and/or perchlorate. Nitrate is a primary contaminant of concern due to the potential ingestion risk to infants that could result in methemoglobinemia ("cyanosis"). This condition, commonly referred to as "blue baby syndrome," occurs when methemoglobin is formed when nitrite is absorbed into the bloodstream. Methemoglobin is not capable of carrying oxygen to the same extent hemoglobin is, and the skin takes on a blue pallor because the bloodstream is carrying less oxygen. Because of a higher pH in their intestinal tracts, infants tend to be much more susceptible to this condition. Most cases of infant methemoglobinemia are associated with exposure to nitrate in drinking water used to prepare infants' formula at concentrations greater than 20 milligrams per liter (mg/L).

The health effects of perchlorate are still being debated. At high oral doses, perchlorate competes with iodide in the thyroid to reduce hormone production. The impacts of low doses are still being researched. The ecological risks associated with perchlorate are uncertain at this time.

There may be some potential adverse effects to plants, soil organisms, and aquatic organisms from metals. The ecological assessment identified raptors, duck species, and selected endangered fish species as potential receptors to chemical exposure from the Site.

4.0 Remedial Actions

The following sections summarize the remedial actions selected, as well as the implementation, operation, and maintenance of the remedial systems.

The ROD for the Site was signed on September 30, 1994. The selected remedy presented in the ROD addressed five separate media components:

- Media Component 1: Perched Groundwater Aquifer
- Media Component 2: Shallow Groundwater Aquifer (later subdivided to northern and southern)
- Media Component 3: Inactive Ponds 4A, 4B, 5A, 5B, 6A, 6B, 7, 8, and Dynagel Pond
- Media Component 4: White Waste and Drum Storage Area
- Media Component 5: Wash 3 Area (Excluding OBOD Area)

The selected remedies, as stated in the ROD, were intended to clean up the nitrate contamination in the perched groundwater zone and the shallow aquifer and provide several different clean-up measures for the soils contamination. In addition, further investigative work was stated in the ROD. These actions are described below.

Direct Remedial Actions

Direct remedial actions include:

- Extracting and treating the perched groundwater by forced evaporation (brine concentrator) in conjunction with treatment of the company's process wastewaters to meet the federal and state drinking water standard of 10 mg/L for nitrate.
- Extracting and treating the shallow aquifer by use of constructed wetlands to meet the federal and state drinking water standard of 10 mg/L for nitrate and recharging the treated water through wetlands, agricultural irrigation, discharge, or some combination of methods as determined during remedial design.
- Replacement of contaminated shallow aquifer domestic wells with deep aquifer wells.
- Excavating designated areas to clean-up standards.
- Consolidating and transporting excavated materials to an off-site permitted facility for treatment and disposal.

- Constructing a low-permeability clay cap over the contaminated soils in the inactive evaporation ponds.

Further Investigation / Monitoring

Further investigation and monitoring include:

- Installing additional groundwater monitor wells to determine the lateral extent of nitrate contamination in the shallow aquifer and the perched zone.
- Conducting a monitoring program to collect chemical water quality data and water levels.
- Conducting aquifer tests and groundwater modeling to ascertain what potential impacts, if any, pumping will have on downstream water users due to the value of groundwater in the region.
- Monitoring long-term effectiveness and performance of remedial actions.
- Monitoring the clay cap (if installed in the future on any Inactive Ponds) on at least an annual basis to ensure that the integrity of the cap is maintained and that the ponds do not act as continuing sources of groundwater contamination.
- Implementing institutional controls so that future use of the Site is compatible with the remedial goals and maintaining the protection provided by any clay caps.

The ROD mandated institutional controls at the ANP site to prohibit shallow aquifer groundwater use for drinking purposes.

Restrictions on the uses of the capped areas of the Site were also mandated. Only those uses that would not adversely affect the cap would be allowed, in order to maintain the integrity of the caps. Some of the uses that may be compatible with the caps include recreation (e.g., picnic areas) and light storage. Uses that are unlikely to be compatible include heavy equipment storage, enclosed buildings, and any structure that would compromise the integrity of the clay cap during construction.

The further investigation outlined in the ROD allowed for additional hydrogeological data gathering, and identification of additional contaminated soils and waste materials. On April 16, 1997, ESD #1 for the Site was signed and governed the following:

1. Allow for extraction and treatment of the nitrate-contaminated shallow aquifer groundwater in the southeast portion of the Site by a constructed wetlands (rather than by a brine concentrator). This includes the treatment of perched groundwater extracted once it has naturally migrated to the shallow aquifer.

2. Allow for two locations—northern and southern —for siting the constructed wetlands to treat the nitrate-contaminated shallow aquifer, including the use of a pipeline or several pipelines to carry the nitrate-contaminated groundwater from the extraction wells to the treatment areas.

3. Allow for the recharge of the treated perched and shallow aquifer groundwater by gravity-flow pipeline discharge to a shallow aquifer recharge location in Wash 3 for the northern area wetlands and to a shallow aquifer recharge location in Wash 6 for the southern area wetlands.

4. Allow for additional shallow aquifer extraction wells to be located in areas of high concentrations of nitrate to expedite groundwater cleanup.

5. Allow for characterization, removal, treatment, and disposal in a hazardous waste or solid waste disposal facility of any newly-discovered contaminated soils materials not previously identified in the ROD.

In addition, ESD #1 subdivided Media Component 2 to 2A encompassing Northern Area Shallow Groundwater Aquifer and 2B encompassing Southern Area Shallow Groundwater Aquifer.

ESD #2 was issued on September 29, 2000 to:

1. Establish clean-up standards for compounds or COCs that were either recently detected at the Site, or site soils or sediments without a ROD-defined clean-up standard.

2. Modify soils clean-up remedies to "No Further Action" for selected soil media components where hazardous substances were not detected or levels of contamination do not exceed EPA selected clean-up standards.

Investigations and events following ESD #1 revealed the need for modifications to the ROD pertaining to soil only. Waste materials previously identified as potentially contaminated in 1994 , including the paraffins (Media Component 5), the ceramic packing materials (Media Component 4), and the miscellaneous construction materials (Media Component 4), subsequently were sampled and determined to be non-hazardous and, therefore, did not require remedial action. Additional COCs were detected that were not previously included in the 1994 ROD list of cleanup standards. Further, subsequent analysis of pond sediments identified for on-site capping indicated that the concentrations of metals in the sediments did not appear to exceed soil clean-up standards, but no such standards for this media component were selected in the 1994 ROD. In particular, clean-up standards were not set for nitrates and metals in soils, as capping was the ROD-recommended remedy. Additionally, on December 4, 1997, the State of Arizona adopted new Soil Remediation Levels (SRLs) (Arizona Administrative Code, Title 18, Chapter 7, Appendix A), which are enforceable standards.

ESD #2 expanded the soils media components that require remedial action or a determination of "no further action" to include one additional area (Media Component 7) and the components were revised as follows:

- Media Component 3: <u>Inactive Pond Soils and Sediments</u>
  - Inactive Pond Sediments – nitrate and metals
  - Edge of Inactive Pond 4B – asbestos-containing materials

- Media Component 4: <u>White Waste Materials and Drum Storage Area</u>
  - White Waste Area – arsenic-contaminated soils
  - Drum Storage Area – Drums containing vanadium pentoxide
  - Drum Storage Area – "Unknown" Drum containing liquid di-ethylene glycol

- Media Component 5: <u>Wash 3 Area</u>
  - TOSA – DNT contaminated soil and drums excavated from the Wash 3 Area
  - Wash 3 – DNT type drums and DNT contaminated soil

- Media Component 7: <u>Other Drums</u>
  - Warehouse 244 – Drums containing pure DNT
  - Wash 5 – Drum containing naphthalene
  - Wash 5 – DNT type drums containing soil

Both ADEQ and EPA have been actively involved at the Site. Response activities were initiated by the State of Arizona in 1980, and various response activities have been undertaken by both EPA and the State of Arizona since that time. In a June 1992 coordination meeting, EPA and ADEQ agreed to split each agency's respective roles to ensure that the clean-up activities performed by ANP were comprehensive and did not duplicate company or agency effort. It was agreed that ADEQ would be responsible for ensuring ANP's compliance with State requirements for aquifer protection, air quality, and hazardous waste management under RCRA. EPA, in turn, would be responsible for overseeing ANP's cleanup of historical contamination at the Site.

In June 1994, ADEQ and ANP signed a CD to bring ANP into compliance with hazardous waste requirements under RCRA and APP requirements. ADEQ and EPA have continued to coordinate activities throughout the ongoing cleanup process. As a result, certain actions have fallen under the jurisdiction of ADEQ and are not considered part of the Site remedy. Measures which have been conducted as part of the State CD can be found in Section 4.9, Summary Status of Cleanup Activities Conducted Under State CD.

EPA currently is compiling data necessary for future remedy changes to address perchlorate, a new COC, discovered in 1998. During the period of 1999 through 2002, investigative studies have been conducted to determine the lateral extent of perchlorate in the perched and shallow aquifer, and to confirm that perchlorate is not present in the San Pedro River. Other studies have been conducted to isolate specific microorganisms at the Site that appear to be biodegrading the perchlorate. Both a draft Supplemental FS Report and a draft Monitored Natural Attenuation Report have been completed by ANP and are currently undergoing EPA review. In September 2002, in response to EPA and ADEQ requirements, a series of field borings and three new wells are scheduled to be installed to resolve any remaining data gaps. Once the data from these studies are obtained, EPA intends to complete its remedy decision making process for perchlorate and the final southern area shallow aquifer remedy.

The responsibilities that currently fall under the jurisdiction of EPA are listed below and will be discussed in detail in subsequent subsections.

- Installation of deep aquifer replacement wells
- Media Component 1: Perched Groundwater Zone
- Media Component 2A: Northern Area Shallow Aquifer Groundwater
- Media Component 2B: Southern Area Shallow Aquifer Groundwater
- Media Component 3: Inactive Ponds
- Media Component 4: White Waste and Drum Storage Area
- Media Component 5: Wash 3 Area (Excluding the OBOD Area)
- Media Component 7: DNT Drums Located Outside of the Wash 3 Area
- Removal Action: TNT-contaminated Area

4.1 Deep Aquifer Replacement Wells

4.1.1 Remedy

The 1994 RI/FS indicated that nitrate had impacted the shallow aquifer and that eight private wells on nearby properties exceeded drinking water standards for nitrate. To protect public health, the ROD required replacement of the contaminated shallow aquifer private drinking water wells with deep aquifer wells.

Institutional controls prohibiting the use of the shallow aquifer as drinking water, as mandated in the ROD, could not be implemented. The Site is not located in an area designated by Arizona Department of Water Resources (ADWR) as an Active Management Area (AMA). Therefore, ADWR does not have the authority to regulate well construction and to require special well construction standards based on contaminated groundwater and on the potential for cross-contamination between aquifers at the Site. Additionally, even within AMAs, ADWR does not have the authority to strictly prohibit the installation of wells based on water quality conditions. However, ADWR does notify applicants with the intent to drill within a one-mile radius of the ANP property boundaries of the groundwater contamination present at the ANP Superfund Site.

4.1.2 Remedy Implementation and Operation

Eight deep aquifer replacement wells were installed June 14 through September 21, 1994 for replacement of the following domestic water supply wells: D(17-20) 36add1-DR (Jacobs), D(17-20) 36caa-DR (James), D(17-20) 36cad1-DR (McCann), D(17-20) 36cad 2-DR (Vivian), D(17-20) 36cdb-DR (Callaway), D(17-20) 36ddc-DR (Spaulding), D(18-21) 06bcc1-DR (Carnes), and D(18-21) 06bcc2-DR (Wooten) (Figure 6). According to boring logs, all wells are screened within the coarse-grained unit beneath a substantial layer of St. David Clay, comprising the upper unit of the confined deep aquifer. Six of the eight replacement wells were installed with conductor casing throughout the shallow aquifer extending 21 to 22 feet into the St. David Clay aquitard. The two remaining wells, Jacobs and Callaway, were not installed with conductor casing.

Water quality sampling of the replacement wells was performed at approximately 1 month, 6 months, and annually for a period of approximately 2 years following installation. Final water quality sampling of deep aquifer replacement wells was completed in May 1997. Samples were analyzed for metals and other inorganics including nitrate-nitrogen (nitrate-N), dissolved arsenic, fluoride, and strontium. Private replacement well McCann was not sampled in August 1995 because the property was vacant but was subsequently sampled August 1996. Private replacement well Callaway was sampled beyond the 2-year monitoring period in May 1997 and analyzed for turbidity only. Likewise, private well Spaulding was sampled May 1997 and analyzed for lead only due to a one-time laboratory estimated value exceedence in August 1996.

The analytical results were compared with primary and secondary federal maximum contaminant levels (MCL). There were no reported MCL exceedences for metals and inorganic analytes in samples from private wells McCann, Vivian, and Callaway. Lead exceeded MCL in groundwater samples from private wells James, Spaulding, and Carnes, yet were less than the MCL during subsequent sampling events. Private well Wooten exceeded the MCL for arsenic of 0.05 micrograms per liter (μg/L) in 1994 and 1995; however, arsenic concentrations were less than the MCL in subsequent sampling events.

While conducting routine sampling of the Jacobs replacement well as follow-up to the installation, MCLs for both arsenic and fluoride were exceeded. In order to ensure that these exceedences were not a result of an interconnection between the shallow water-bearing unit and the deeper unit in which the well was completed, 1991 and 1992 analytical data from wells completed in the shallow zone near the replacement well were reviewed. No MCL exceedences had occurred in the shallow aquifer during the 1991 and 1992 sampling events; this coupled with the strong upward vertical gradient infer a low probability of fluid transfer between the two aquifers.

Due to the MCL exceedences in the Jacobs deep aquifer replacement well, ANP installed point of use reverse osmosis water treatment systems on the kitchen taps of the three households (trailers) served by this well. The Jacobs are responsible for the operation and maintenance (O&M) of these units. Water quality samples were collected from the tap of the 3 reverse osmosis units located on the Jacobs' property in February 1995, March 1995, August 1995, and August 1996 for fluoride and arsenic, with results indicating no MCL exceedences.

From the analytical data collected, it appears that the replacement well on the Jacobs property, which includes point-of-use treatment by reverse osmosis units, enable delivery of water in acceptable quantities and quality for domestic consumption within the study area.

Private well Kempton exceeded the ROD-mandated clean-up level during May 1995 as shown by three replicate samples (14.3 – 13.1 mg/L). Concentrations fluctuated between 5.6 and 8.4 mg/L, and sampling ceased in May 1997 based on the owner's request. Prior to ANP's installation of the other eight replacement wells, Kempton independently proceeded with installation of a deep aquifer replacement well on his property.

As part of the ROD remedy, institutional controls were established to limit well installation in proximity of the Site. This institutional control is limited to the Arizona Revised Statue 45-605, which states that persons who file notice with ADWR of their intent to drill within 1 mile of the Site will be notified of the State Superfund site and the extent of known contamination. In conjunction, ANP is in close contact with the local drilling companies, community, and real estate agencies to inform people of the known groundwater contamination within the study area.

4.2 Media Component 1: Perched Groundwater Zone

4.2.1 Remedy

Media Component 1 comprises the perched groundwater zone underlying the south end of the ANP property in the vicinity of the Formerly Active Ponds. The ROD identified this groundwater to be impacted with nitrate, arsenic, and fluoride as a result of seepage of wastewater from the Formerly Active Ponds.

The ROD identified the use of an extraction system for pumping the perched groundwater into the brine concentrator. ANP ceased discharge of process wastewaters to the evaporation ponds in April 1995. As a result, the perched zone dewatered very rapidly and the nitrate concentrations dropped to levels that could be treated in a constructed wetlands. ESD #1 was issued, which, among other actions, allows for the perched groundwater to be extracted and treated within a constructed wetlands in conjunction with the extraction and treatment of the nitrate-contaminated shallow aquifer groundwater in the southeast portion of the Site.

4.2.2 Remedy Implementation

Arsenic and fluoride are naturally-occurring in the groundwater at the Site, with suspected elevated concentrations in the perched zone originating from the evaporation in the ponds prior to infiltration to the perched zone. Long-term monitoring results show decreased concentrations of fluoride to less than MCL levels and arsenic concentrations have never exceeded the ROD selected cleanup level of 4.0 mg/L. As a result, these are no longer considered COCs in the perched zone and do not require remedial action.

The recommended remedy in ESD #1 for Media Component 1 has not been implemented due to new technical, chemical, and hydrogeologic information. Historically, perchlorate was commonly used in the manufacturing of explosives. In April 1997, new technology emerged enabling the detection of perchlorate at low levels (4 parts per billion [ppb]). Subsequently, ADEQ and EPA recommended an investigation of perchlorate use at ANP. Perchlorate was discovered throughout the perched groundwater zone with maximum concentrations at piezometer P-03 of 810 μg/L (Figures 7a and 7b). The source was identified as a natural impurity in the Chilean sodium nitrate used for the manufacture of nitric acid and carbagel, imported from 1922 to 1987. Due to the recent developments in low-level detection of perchlorate, the potentially adverse health and environmental effects are uncertain. As a result, construction of treatment wetlands in the southern shallow/perched aquifer area was dismissed as a treatment option until the ecological risks are better understood. Perchlorate monitoring on a quarterly basis has continued for the perched zone since 1999. Nitrate concentrations in perched-zone water remain greater than the ROD selected cleanup level of 10 mg/L in five of the six monitoring points (Figures 7c and 7d)

Remedial design investigations throughout 1999 and 2000 enabled revision of the southern area Site conceptual model and detailed cross-sections (Figures 8a through 8i). This revision identified the Apache Wash Paleochannel as the pathway for the discharge of the perched zone to the southern shallow aquifer near MW-29 (Figures 8b through 8f). Groundwater elevation in perched-zone monitoring well MW-29 has fluctuated and that of shallow aquifer monitor wells MW-15 and MW-21 decreased throughout 2001, while thickness of the perched zone was relatively stable. Therefore it appears that discharge from the perched zone slowed or ceased during 2001 due to decreased hydraulic head. Overall, the thickness of the perched zone has decreased over time (Figure 9).

As a result of the diminishing lateral size of the perched zone, the definition of a discharge pathway, and a study on the potential for MNA, MNA is currently being considered as a treatment option for the southern area perched zone. Evaluation of this remedy is dependant upon confirmation of the LCU, identified as a low-permeability barrier within the southern shallow groundwater aquifer. Hydrogeologic investigations are being conducted during September 2002 and will provide lithologic and hydrogeological information to evaluate the potential for MNA. Therefore, it is not possible to draw conclusions regarding the effectiveness of any remedy for Media Component 1 at this time. The effectiveness of MNA as a remedy may be addressed as an addendum to this report following sufficient monitoring.

4.3 Media Component 2: Shallow Aquifer Groundwater

4.3.1 Remedy

According to the ROD, Media Component 2 comprises the shallow alluvial aquifer along the San Pedro River. The remedies for the shallow aquifer as designated by the ROD were (1) extracting and treating the shallow aquifer by use of constructed wetlands to meet the federal and state drinking water standard of 10 mg/L for nitrate and (2) recharging the treated water through wetlands, agricultural irrigation, discharge, or some combination of these methods as determined during remedial design.

Subsequent to the ROD, groundwater monitoring activities indicated that the nitrate concentrations in the shallow aquifer could be treated within two areas now known as the Northern Area and the Southern Area. The Northern Area is generally located north of the ANP property in the vicinity of shallow aquifer monitor wells MW-17 and MW-18. The Southern Area is located in the southeast boundary of the ANP property in the vicinity of shallow aquifer monitor well MW-15. As a result of these studies, and the fact that the ROD did not specify the recharge method for the treated groundwater, ESD #1 included these provisions pertinent to Media Component 2:

- Allow for two locations (a northern and southern location) for siting the constructed wetlands to treat the nitrate-contaminated shallow aquifer, including the use of a pipeline or several pipelines to carry the nitrate-contaminated groundwater from the extraction wells to the treatment areas.

- Allow for the recharge of the treated perched and shallow aquifer groundwater by gravity-flow pipeline discharged to a shallow aquifer recharge location in Wash 3 for the northern area wetlands and to a shallow aquifer recharge location in Wash 6 for the southern area wetlands.

- Allow for additional shallow aquifer extraction wells to be located in areas of high concentrations of nitrate to expedite groundwater clean up.

4.3.2 Implementation at Media Component 2A: Northern Area

The NARS was constructed in 1997 to remediate nitrate-N-contaminated shallow aquifer groundwater in the Northern Area. The NARS is located in the northwest area of the ANP property boundary and includes:

- Groundwater extraction system pumping from SEW-1.

- Groundwater delivery system comprising 5,100 feet of above- and below-grade piping.

- 4.3-acre treatment wetland comprised of five cells:
  - Primary Denitrification Area (PDA) (South)

- PDA (Center)
- PDA (North)
- Aerobic Nitrification Area (ANA)
- Final Denitrification Area (FDA)

- Treated effluent return system of 2,900 feet of above- and below-grade piping (Figures 10a and 10b).

The NARS is designed to treat extracted groundwater from SEW-1 at a maximum flow rate of 200 gpm, with a maximum inlet nitrate-as-nitrogen concentration of 250 mg/L.

4.3.3 Operation and Maintenance of Media Component 2A

Three stages of remedial implementation were planned: establishment phase; limited scale startup; and full-scale startup.

The establishment phase includes September 1997 through June 26, 2001 and November 28, 2001 to present. The establishment phase was estimated at 2 years; however, due to an unforeseen caterpillar infestation that decreased the carbon source (cattails) within the treatment cells this phase has prolonged. Activities during this period include:

- Seeding with emergent plants in the 4 denitrification cells and submergent plants in the ANA cell.
- Flooding the PDA and FDA using groundwater from extraction well SEW-1.
- Maintaining suitable water level to sustain plant growth.
- Inspecting plant growth.
- Replanting the ANA in the spring of 1999 due to initial establishment failure.
- Removal of non-wetland vegetation.
- Repair of the wetland berms as a result of settlement.
- Installation of staff gauges in the five cells used for water level and water quality monitoring.
- Repeated erosion control.
- Piping modifications and repair.
- Road improvements.
- Addition of a carbon source.

- Ongoing control of caterpillar populations.
- Recording influent flow rates.
- Recording water levels in treatment cells.
- Water quality monitoring in treatment cells, design confirmation piezometer, and the extraction well.
- Repairing the extraction well pump.
- Routine compliance monitoring in accordance with the O&M Plan.

During the initial establishment phase, a total of 85,036,490 gallons of water was intermittently extracted from SEW-1 over a 46-month period at an average instantaneous flow rate ranging from 180 to 220 gpm. The NARS is designed for a maximum flow rate of 200 gpm. The exceedences may be due to the intermittent instantaneous flow, whereas the maximum flow rate is based on continuous flow, yet the validity of this cannot be ascertained as pump times are not presented in the O&M reports. Initially, much of the influent water infiltrated the surface soil and saturated underlying sediments down to the underlying clay base. Evaporation and transpiration also consumed portions of the treatment water. Design confirmation piezometer DCP-12 was installed during wetlands construction east of the FDA treatment cell where the subsurface clay was located at the greatest depth. Following initial flooding of the wetland, water in this piezometer was observed as having high concentrations of nitrate-N. This was thought to be from leakage through the clay cut-off wall due to settlement cracking. A subsequent boring investigation indicated that the clay in the cut-off wall was continuing to saturate and swell, sealing the settlement cracks. Water levels in DCP-12 appear to have stabilized (Figure 11). Depth-to-water measurements are given for each of the treatment cells; however, a water balance is not presented in the O&M reports.

Limited-scale startup was initiated June 26, 2001. This phase ceased November 28, 2001. As cattails entered their senescent stage, the dissolved oxygen and nitrate-N concentrations increased and treatment cell water temperature decreased, indicating a reduction in the systems denitrification efficiency. During limited-scale startup, activities included:

- Monitoring and maintaining plant establishment.
- Ongoing control of caterpillar populations.
- Monitoring and maintaining the absence of non-wetland vegetation.
- Visual inspection of ecological conditions.
- Ongoing erosion control.
- Routine pipe, mechanical and electrical inspection, maintenance and repair.

- Denitrification experiments evaluating the addition of carbon sources leading to the weekly addition of molasses.

- Daily recording of the distance discharged water flowed above surface from the temporary discharge point at Wash 3.

- Documenting the operating parameters including operating pressures, total gallons extracted from SEW-1, effluent flow rates, and pump run time.

- Daily static water level measurements at monitoring well MW-10 and design confirmation piezometer DCP-12.

- Sampling for performance and compliance monitoring including, but not limited to: bi-weekly monitoring of pH and nitrate-N, weekly turbidity and total dissolved solids measurements, and weekly fecal coliform and *Escherichia coli* (E. coli) sampling.

- Routine compliance monitoring as set forth in the O&M Plan.

- Weekly wetlands status updates including contaminant and bacterial concentrations were submitted by electronic correspondence to the EPA and ADEQ.

Limited discharge of water from the FDA was initiated at a regulated rate not to exceed 30 gpm into Wash 3 from the alternative effluent location. During this time, 14,411,110 gallons of water was intermittently extracted from SEW-1 over a 5-month period at an average instantaneous flow rate of approximately 210 gpm. The total extraction from SEW-1 from establishment phase to November 28, 2001 was 99,447,600 gallons while discharge from the Parshall Flume was approximately 415,158.20 gallons. Discharge from the Parshall Flume ranged from 0.05 to 65 gpm, averaging 21 gpm. The distance effluent traveled down Wash 3 ranged from 0 to 900 ft. Concentrations of nitrate-N in samples from SEW-1 ranged from 130 to 150 mg/L during limited-scale startup, while effluent ranged from 0.02 to 120 mg/L (Figure 12). Discharge of nitrate-N concentrations in effluent >10 mg/L was permitted under limited-scale startup in the alternative discharge zone of Wash 3, where it was not anticipated discharged water would reach the San Pedro River by surface flow. Since 1997, nitrate-N concentrations in SEW-1 have decreased from approximately 210 mg/L to 140 mg/L. It is unclear whether this decrease can be attributed to natural attenuation, migration to the San Pedro River, or mass removal. Approximated mass removal is not provided in the O&M reports. A localized depression in the shallow aquifer near monitor wells MW-17 and MW-18 developed as a result of pumping at extraction well SEW-1 (Figure 13).

Full-scale startup has not yet been initiated. After completing construction, planting, and establishment of the wetlands vegetation during 1998 to 2000, initial startup testing began in 2001. In late summer 2001, the NARS was treating the nitrate within a range of 10 mg/L, the cleanup standard and discharge limit. After seasonal shutdown in the winter of 2001, testing in 2002 indicated that the NARS was not treating the nitrate as effectively as the prior season. During 2002, methods for optimizing treatment efficiency were implemented including recirculating extracted groundwater within the wetlands' treatment cells and periodic addition of a carbon source and phosphorous to make up for identified deficiencies. Because nitrate levels have not dropped to below 10 mg/L, no discharges are scheduled in 2002. It is anticipated that by summer 2003, the NARS should be functioning effectively as intended so that full-scale treatment and discharge can commence. As a result, evaluation of the effectiveness of this remedy during full-scale operation is not possible at this time.

4.3.4 Implementation at Media Component 2B: Southern Area

The Southern Area shallow groundwater aquifer is located near the southeast boundary of the ANP property in the vicinity of monitor well MW-15. Media component 2B is incised by Wash 6. The revised site conceptual model identifies the source of contamination in this media component as the flow from the perched water zone, discharging in the vicinity of MW-21. The revised conceptual model also hypothesized that the MCA (western portion) the and SPA (eastern portion) are hydraulically divided by the LCU which allows for very low flow rates dependent upon the hydraulic head. The existence of the LCU was based on differences in: hydraulic head, lithofacies, hydrochemical facies, and the distribution of contaminants. Recent groundwater monitoring results indicate that flow is westward across the LCU, resulting in dilution of contaminants within the MCA (Hargis + Associates, Inc. 2002a). Field investigations are underway by ANP during September 2002 to obtain the missing lithologic data for confirmation of the aerial extent of the LCU.

During the 1998 investigation and subsequent groundwater monitoring activities, perchlorate was identified in the MCA portion of Media Component 2B (Figures 14a – 14d). Perchlorate has been detected in the following monitoring wells: MW-15, MW-21, MW-23, and MW-24. Nitrate concentrations in the shallow southern zone are greater than the ROD-selected cleanup levels in monitoring wells MW-13, MW-15, and MW-21 (Figures 14d-14h).

ESD #1 allowed for integrated management of the perched aquifer and shallow groundwater aquifer. Therefore, similar to the remedial progress of the perched aquifer, neither the ROD nor ESD #1 remedies were implemented. Currently, MNA is being considered as a treatment option for the southern area shallow zone. The effectiveness of MNA as a remedy may be addressed as an addendum to this report following sufficient monitoring.

4.4 Media Component 3: Inactive Ponds

4.4.1 Remedy

Media Component 3 includes nine unlined ponds at the ANP site that have been classified as inactive. This includes Ponds 4A, 4B, 5A, 5B, 6A, 7, 8, and the Dynagel Pond. The ROD remedy consisted of:

- Clay capping of inactive ponds with no disturbance to contaminated soils.
- Implementing institutional controls so that future use of the Site is compatible with the remedial goals and maintaining the protection provided by the clay caps.

However, three developments warranted reconsideration of the need for capping:

- Several of the ponds were determined to have a beneficial function in terms of flood protection and runoff control and, therefore, safety and surface water management at the Site.
- A remedial design investigation (RDI) was performed. As part of the RDI, supplemental characterization of the inactive ponds was performed in March and April of 1998. The analytical results of soil samples collected from the pond areas during the RDI indicated concentrations of the COCs were not significant in comparison with their respective potential cleanup standards.
- Asbestos Containing Material (ACM) was discovered within Pond 4B in June 2000. The ACM originated from the dismantling of a former acid plant in the mid-1970s and other possible sources. The remedial action selected for the ACM was the removal and disposal.

At the time of its issuance, ESD #1 did not apply to Media Component 3. However, the provision of ESD #1, which "allows for the characterization, removal, treatment, and off-site disposal of any newly discovered contaminated soils materials not previously identified in the ROD pursuant to an EPA-approved Soils RD Workplan" came to apply to Media Component 3 in 2000 with the discovery of ACM.

The ROD-selected soil cleanup standards for all the COCs in inactive ponds identified at the time, with the exception of the metals and nitrate. EPA did not select a clean-up standard for metals and nitrate because the 1994 ROD selected capping as a remedy and soil removal was not planned. However, additional sediment sampling of the inactive ponds was conducted because of uncertainties regarding the historical use of these ponds and whether the sediments did or did not contain hazardous substances that exceeded clean-up standards. Eventually it was determined, through historical accounts based on available plant records, employee interviews, reports, historical aerial photographs, and inferences drawn from present-day observations and plant operations, that Inactive Ponds 4A, 4B, 5A, 5B, 6A, 6B, and 8 were not used for historical wastewater discharge. Inactive Pond 7 and the Dynagel Pond are known to have received past wastewater discharges.

Consequently, ESD #2:

- Established cleanup standards for compounds or COCs, which were either recently detected at the Site or without ROD clean-up standards, identified in site soils or sediments.

- Modified soil clean-up remedies to "No Further Action" for selected soil media components where hazardous substances were not detected or levels of contamination did not exceed EPA selected clean-up standards. This allowed ANP not to cap any pond which did not exceed standards.

The clean-up standards set forth by ESD #2 included standards for the metals identified in pond sediments and provided a provision for an asbestos standard. An asbestos standard was not calculated at the time of ESD #2. The ACM Disposal Area Remedial Action Work Plan stated "A soil cleanup standard for ACM does not exist at the present time, because the material is handled as a special waste. In the absence of an applicable standard, consideration has been give to a cleanup goal of 1 percent ACM by volume of soil" (Hargis + Associates, Inc., Appendix A 2001b)

4.4.2 Remedy Implementation

During December 2000, approximately 320 tons of ACM-containing soils were excavated from the northeast section of Pond 4B in accordance with an EPA-approved technical work plan. The excavation measured approximately 67 feet by 15 feet by 10 feet deep. The excavated ACM-containing soil was transported off site in several roll-off bins under U.S. Department of Transportation-required manifest to the Butterfield Station Landfill in Mobile, Arizona (EPA ID AZD983483813) for disposal. Post-excavation bulk confirmation samples ACM-01 through ACM-04 were collected from the approximate midpoints of the excavation sidewalls, from approximately 3 feet bls. Samples ACM-05, -06, and –07 were collected along the long axis of the excavation bottom surface, at locations equidistant from samples ACM-01 and ACM-03. The samples were analyzed for percent-ACM content. Three surface soil samples (samples 20AP1213ACM-1, -2, and –3) were collected to evaluate soil ACM concentrations between the excavation and the roll-off bin loading area and at a location where some material from a loaded roll-off bin was spilled on the ground. The analytical results of the confirmation and surface soil samples indicated that concentrations of ACM in residual soils were less than 1 percent by volume.

The sidewalls of the Pond 4B excavation were knocked down, and the excavation was backfilled to grade by ANP following receipt of analytical results.

A review was performed of all of the available data for Media Component 3. Characterization of the sediments and soils within the inactive ponds was performed during three different events: the preliminary investigation, RI, and RDI.

The preliminary investigation was conducted August through October 1987. During the preliminary investigation, two background surface soil samples, seven pond sediment composite surface soil samples, and five discrete subsurface soil samples were collected from the inactive ponds and vicinity. All samples collected during the preliminary investigation were analyzed for Target Compound List (TCL) metals, strontium, ammonia, total Kjeldahl nitrogen, nitrite plus nitrate, nitrite, pentaerythritol tetranitrate, and nitroglycerin.

The remedial investigation was conducted April through May 1990. During the remedial investigation, four background surface soil samples and 15 discrete background subsurface soil samples were collected from areas near the inactive ponds. In addition, two discrete surface pond sediment soil samples and 18 discrete subsurface soil samples were collected from Pond 7 and the Dynagel Pond. The surface soil samples were analyzed for TCL semivolatile organic compounds (SVOCs), TCL pesticides and polychlorinated biphenyls (PCBs), TCL metals, strontium, and nitrate-N. The subsurface soil samples were analyzed for TCL SVOCs, TCL volatile organic compounds (VOCs), TCL pesticides and PCBs, TCL metals, strontium, nitrate as nitrogen (nitrate-N), and toxicity characteristic leaching procedure.

The COCs identified in the ROD for the inactive ponds were selected by EPA based on an evaluation of the analytical data obtained during the preliminary investigation and remedial investigation screened against predetermined selection criteria for COCs.

Supplemental characterization of the inactive ponds was performed during the RDI. This investigation focused on further defining the concentrations of ROD-selected COCs in the surface soils comprising the pond bottoms. ANP received EPA approval of a proposed work plan to perform supplemental characterization of the ponds in March 1998 and completed the work in April 1998. The RDI supplemental characterization consisted of collecting three composite surface soil samples from each inactive pond. Each pond was divided into approximately three equal sections (i.e., the inlet section, the mid-section and the distal/outlet section), and a composite surface soil sample consisting of 12 aliquots was collected from each pond section. All soil samples were analyzed for antimony, arsenic, barium, beryllium, chromium (total), lead, manganese, and nitrate-N. Representatives of ADEQ collected split samples from Pond 7 and the Dynagel Pond.

A summary of the data review for Media Component 3 as stated in *Remedial Action Implementation Report for Media Component 3 (Inactive Ponds)* is as follows:

- Analytical results for nitrate-N, summed nitrate-N+nitrite-N, barium, total chromium, and manganese in surface and subsurface soil samples collected from all background locations and all of the inactive ponds indicate that concentrations of these ROD-selected COCs were at concentrations less than the EPA-selected cleanup standards.

- One subsurface and three surface soil samples collected from Pond 7 and the Dynagel Pond contained antimony at concentrations slightly greater than the antimony residential SRL of 31 milligrams per kilogram (mg/kg), but much less than the non-residential SRL of 680 mg/kg. None of the background and remaining inactive pond soil samples contained antimony at concentrations greater than the EPA-selected cleanup standard.

- Subsurface soil samples collected from Pond 7 and the Dynagel Pond contained arsenic at concentrations greater than the arsenic SRL methodology-based background concentration of 19.23 mg/kg, which is greater than both the arsenic residential/non-residential SRL of 10 mg/kg. These concentrations occur in subsurface soils greater than 3 feet bls in Pond 7 and greater than 2.5 feet bls in the Dynagel Pond. The depth of contamination extends to at least approximately 40 feet bls beneath both ponds. The total vertical depth of these concentrations was not determined at either pond during the three characterization events. None of the remaining surface and subsurface soil samples collected from any of the inactive ponds contained arsenic at concentrations greater than the EPA-selected cleanup standard.

- One surface and several subsurface background soil samples contained arsenic at concentrations greater than the EPA-selected cleanup standard. Some subsurface background soil samples contained arsenic at concentrations more than triple the respective residential and non-residential SRL.

- One pond sediment and four subsurface soil samples collected from Pond 7 and the Dynagel Pond contained beryllium at concentrations equal to or slightly greater than the beryllium residential SRL of 1.4 mg/kg, but less than the beryllium non-residential SRL of 11 mg/kg. Analytical data indicate that Pond 7 beryllium concentrations greater than the beryllium clean-up standard were detected at depths greater than 5 feet bls, and that Dynagel Pond sediments equal to the beryllium clean-up standard occur in pond sediments. None of the remaining inactive pond soil samples contained beryllium at concentrations greater than the clean-up standard.

- Several surface and subsurface background soil samples contained beryllium at concentrations greater than the beryllium clean-up standard. Some of the background beryllium concentrations are greater than the highest beryllium concentrations detected at Pond 7 and the Dynagel Pond.

- Only one sample, a duplicate preliminary investigation surface soil sample collected from Pond 7 contained lead at a concentration greater than the EPA-selected cleanup standard of 400 mg/kg. This lead concentration appears to be a significant deviation from the range of lead concentrations in the remaining soil samples. None of the background and remaining inactive pond soil samples contained lead at concentrations greater than the lead clean-up standard.

As stated in the *Remedial Action Implementation Report for Media Component 3 (Inactive Ponds)*, ANP believes that no further action is required for inactive ponds 4A, 4B, 5A, 5B, 6A, 6B, and 8. This is based on all available analytical data, which indicate that none of the surface and subsurface soil samples collected from these ponds exceed EPA-selected cleanup standards. Additionally, all ACM has been successfully removed from Pond 4B.

Despite exceedences of the respective clean-up standards for antimony, arsenic, and beryllium at Pond 7 and the Dynagel Pond, ANP believes that any residual risks associated with these ponds are within an acceptable range. This determination is made on the basis of:

- Residual concentration of antimony and beryllium are less than non-residential SRLs.
- Occurrences of arsenic exceedences were at depth.
- The Baseline Public Health Evaluation/Ecological Assessment performed by ICF/Bechtel in 1992 did not indicate unacceptable risk levels in conjunction with the arsenic concentration for the Site.

Whether or not further action is required at Media Component 3 remains to be determined. A SLERA, using *Guidelines for Ecological Risk Assessment, US EPA* updated May 14, 1998 is currently being performed. The findings of this assessment will determine if further actions are necessary to protect the environment at Media Component 3.

4.5 Media Component 4: White Waste and Drum Storage Area

4.5.1 Remedy

Media Component 4 comprises the Waste Storage Area. The Waste Storage Area encompassed the White Waste Area and the Drum Storage Area. The White Waste Area consisted of a white material stockpile believed to be composed primarily of calcium and magnesium carbonate and associated soil containing arsenic. Within the Drum Storage Area, some drums contained spent vanadium pentoxide, other ceramic packing material, and one drum containing an unknown substance.

The ROD-selected remedy consisted of excavating and removing nitrate-contaminated soils and drums of spent vanadium pentoxide from the White Waste Material and Drum Storage Area to an off-site facility for treatment and disposal.

Investigations subsequent to the ROD yielded new information and matters not addressed in the decision document. The ROD did not set forth a soil standard for arsenic. In addition, waste materials previously identified as potentially contaminated in the 1994 ROD or the 1994 FS subsequently were sampled and determined to be non-hazardous. Consequently, ESD #2 set forth a clean-up standard for arsenic and designated the ceramic packing materials construction waste in Media Component 4 as No Further Action (non-hazardous waste).

4.5.2 Remedy Implementation

Remedial action activities in Media Component 4 were conducted between January and July 2000. They included the removal and disposal of spent vanadium pentoxide catalyst and the removal and disposal of ceramic packing materials and white waste material.

Approximately 24 tons of spent vanadium pentoxide catalyst mixed with soil, 6 tons of drum waste, and 62 empty drums were removed and transported to U.S. Ecology, Inc. Beatty Landfill in Beatty, Nevada (EPA ID No. 330010000).

Approximately 165 tons of ceramic packing materials were transported to a municipal landfill, Huachuca City Landfill, Huachuca City, Arizona. Approximately 100 tons of pure white waste materials and approximately 700 tons of mixed white waste materials were removed and transported to La Paz County Landfill in Parker, Arizona.

In February 2000, eight confirmation samples were collected from the Waste Storage Area where the drums containing spent vanadium catalyst were located. The samples were analyzed for total vanadium. The analytical results indicated that total vanadium concentrations ranged between 21 to 44 mg/kg, and were below the ROD cleanup standard of 820 mg/kg for total vanadium.

Nineteen confirmation soil samples were collected from the White Waste Area in February 2000. The 19 soil samples were analyzed for arsenic by EPA Method 6010. Analytical results indicated that the arsenic concentrations were less than the laboratory detection limit of 5 mg/kg for arsenic. Media Component 4 was remediated according to the remedial action work plan and approved by EPA. Media Component 4 meets the requirements of the UAO Scope of Work.

During the remedial action for Media Component 4 in the Waste Storage Area, miscellaneous construction debris was removed and placed into roll-off bins along with the ceramic packing material. In accordance with an approval letter issued by the EPA, the miscellaneous construction materials, along with the ceramic packing material, were transported to Huachaca City Landfill, Huachuca City, Arizona (ADEQ ID No. 40550). Due to the non-hazardous nature of the material, confirmation sampling was not performed.

In August 2000, the remedial action implementation report for Media Components 4, 5, and 7 was issued.

No O&M activities are required in conjunction with remedial actions for Media Component 4.

4.5.3 Modifications to Remedial Action Work Plan

Minor modifications to the remedial action work plan for Media Component 4 were necessary for the spent vanadium pentoxide. The modification was approved by the EPA prior to implementation.

Additional soil confirmation sampling was performed in three locations. One sample was obtained on the northeast edge of the primary confirmation sampling grid (VAN-04). Two other confirmation soil samples (VAN-01, VAN-02) were collected to the northeast of the vanadium pentoxide drums to confirm that the area underlying the roll-off bin loading area was not contaminated. Confirmation soil samples were only analyzed for total vanadium, instead of total vanadium and vanadium pentoxide as specified in the remedial action work plan.

4.6 Media Component 5: Wash 3 Area (Excluding OBOD Area)

4.6.1 Remedy

Media Component 5 is defined as the Wash 3 Area located in the western portion of the ANP property line, excluding the OBOD Area. Between 1991 and 1993, previously excavated drums and DNT contaminated soils from Wash 3 were removed to the TOSA located between Inactive Ponds 6A and 6B.

The remedy selected by the ROD was excavating and removing lead and DNT contaminated soils from the Wash 3 Area (excluding the OBOD) to an off-site facility for treatment and disposal.

Following additional investigations, ESD #2 modified the ROD such that the components that made up Media Component 5 were:

- TOSA – DNT contaminated soil and drums excavated from the Wash 3 area.
- Wash 3 – DNT type drums and DNT contaminated soil.

ESD #2 also modified the paraffins clean-up standard to the Arizona residential SRL for Hydrocarbons (C10 – C32). A provision was made for the disposal of paraffins as a non-hazardous waste.

4.6.2 Remedy Implementation

Media Component 5 remedial activities included the removal of approximately 290 tons of DNT contaminated soil and 25 tons of drums and plastic liner from the TOSA between December 13, 1999 and January 21, 2000. Media Component 5 sampling included a series of field verification soil sampling and laboratory confirmation soil sampling. On February 15, 2000, one confirmation sample was collected from Wash 3 beneath the area of excavation.

DNT was not detected above the laboratory detection limit of 0.25 mg/kg. One of the 13 confirmation soil samples collected from the TOSA on February 16, 2000 indicated an exceedence of the ROD-selected clean-up standard of 140 mg/kg of 2,4-DNT. On June 28, 2000, an additional 13 tons of DNT impacted soil were excavated and placed in a roll-off bin for disposal from the TOSA. In accordance with an approval letter issued by EPA, the excavated soils and liner were transported to the landfill operated by U.S. Ecology, Inc. in Beatty, Nevada (EPA ID No. 330010000).

Following excavation on June 28, 2000, five additional confirmation samples were collected on July 12, 2000. The results indicated the TOSA soil was below the ROD-selected clean-up standard for 2,4-DNT. No O&M activities were required in conjunction with remedial actions for Media Component 5 in 2000.

In August 2000, the remedial action implementation report for Media Components 4, 5, and 7 was issued.

Media Component 5 was remediated according to the remedial action work plan and approved by EPA. Media Component 5 met the requirements of the UAO Scope of Work.

4.7 Media Component 7: DNT Drums and Waste Outside Wash 3 (Wash 5/ Warehouse 244)

4.7.1 Remedy

After the issuance of the 1994 ROD, additional drums were discovered at the Site with unknown, uncharacterized contents. ESD #1 expanded the soils remedy to include the "characterization, removal, treatment, and off-site disposal of any previously unidentified waste materials discovered in any of the soils on site."

The on-site areas of soils contamination not associated with any pre-existing Media Component discovered after the ROD and ESD #1 include: 110-gallon drums inside of Wash 5 containing soils (later combined with DNT contaminated soils); one 55-gallon drum in Wash 5 containing naphthalene; one "unknown" 110-gallon drum determined to contain di-ethylene glycol; drums of pure DNT and drums of mixed DNT and soil in Warehouse 244; and TNT-contaminated soils on a slope west of the facility's operations area.

Based on post-ROD investigation and analyses, the soils media components at the Site were expanded to include one additional media component area (Media Component 7).

Media Component 7: <u>Other Drums</u>

- Warehouse 244 – Drums containing pure DNT

- Wash 5 – Drum containing naphthalene
- Wash 5 – DNT type drums containing soil

The TNT-contaminated soils were cleaned up as a removal action, pursuant to the requirements in the EPA November 9, 1999 Removal Action Memorandum.

DNT standards set forth in the ROD apply to Media Component 7.

4.7.2 Implementation

Media Component 7 originally comprised the DNT drums located in three areas outside Wash 3. This includes the Wash 5 drums and Warehouse 244 drums. However, during remedial activities at Media Component 4, an additional drum was discovered and included.

Nine 55-gallon drums containing pure DNT and 14 drums of DNT mixed with soil were removed from Warehouse 244 and transported to the Safety Kleen incinerator facility located in Aragonite, Utah. Warehouse 244 was swept clean, and the concrete floor was inspected for staining and visible spillage. The sweepings were also sent off site for disposal to the Safety Kleen incinerator facility. Eleven drums from Wash 5 were removed off site between January 18, 2000 and January 21, 2000. Ten drums were identified as containing DNT and were sent off site to the landfill operated by the U.S. Ecology, Inc. in Beatty, Nevada. One drum removed from Wash 5 contained liquid naphthalene with minor concentrations of polynuclear aromatic hydrocarbons and was sent for disposal to the East Carbon Development Corporation (ECDC) in East Carbon, Utah.

A composite sample of the sweepings from Warehouse 244 was collected on January 21, 2000. The sample was analyzed for DNT. The resulting data indicated that Warehouse 244 is within the ROD clean-up standard of 140 mg/kg of 2,4-DNT. One soil sample was collected from below the 110-gallon drum excavated from Wash 5 and was analyzed for DNT. DNT was not detected at concentrations greater than the laboratory detection limits of 0.25 mg/kg.

In addition, a 110-gallon drum typical of the drums used to store DNT was found in the Waste Storage Area during remediation of Media Component 4. This drum contained an unidentified liquid. On February 29, 2000, the drum was opened and sampled by Philips Services Corporation (PSC) personnel in accordance with the EPA-approved Contractor Work Plan. Because of its unknown nature, extreme care was exercised while opening this drum.

Upon opening, a small quantity of the liquid was evaluated using field test methods to identify whether potential hazardous properties were present. Field evaluations included: physical description, pH, ignitability, reactivity to water, miscibility in water, positive/negative PCB field test kit, hot copper wire, and drop testing for shock sensitivity. No hazardous properties associated with the liquid were determined as a result of these tests.

After completion of the hazardous characteristics testing, four liters of the liquid were sampled and shipped for off-site analysis.

The samples were shipped to NEL Laboratories in Phoenix, Arizona (Sample ID No. UD-01). By comparing the mass spectrophotometric data with an associated database of compounds, the laboratory concluded the liquid was 2,2'-oxy-bis-ethanol (aka di-ethylene glycol). Discussions with ANP personnel and a review of historical specification sheets for dynamite-grade raw materials further supported the laboratory's conclusion. ANP historically used dynamite-grade "ethylene glycol" and glycerin in a former process. The presence of glycerin was deduced on the basis of historical operator knowledge, as well as visual observations of the foaming/soapy characteristics of the liquid during drum sampling.

On June 28, 2000, the contents of the unknown drum were transferred to two 55-gallon steel drums. The two 55-gallon drums and empty 110-gallon drum were transported on July 25, 2000 to ENSCO, located in El Dorado, Arkansas (EPA ID No. ARD069748192) for incineration and disposal.

Confirmation sampling for the unknown drum was not performed. The drum did not contain a RCRA hazardous waste and was not previously identified as a CERCLA waste, and because the drum's condition indicated that it had not leaked (the drum released pressure when opened), no confirmation sampling was deemed necessary.

No O&M activities were required in conjunction with remedial actions for Media Component 7 in 2000.

In August 2000, the Remedial Action Implementation Report for Media Components 4, 5, and 7 was issued.

Media Component 7 was remediated according to the remedial action work plan and approved by EPA. Media Component 7 meets the requirements of the UAO SOW.

4.7.3 Modifications to Remedial Action Work Plan

Minor modifications were made to the remedial action work plan for Media Component 7. The modifications listed below were EPA approved prior to implementation of the modification.

Characterization of Unknown Drum

In accordance with EPA approval, the liquid from the drum was analyzed for nitrotoluene in addition to the previously specified analytical methods outlined in the remedial action work plan. 2,4- and 2,6-DNT were also added to the analyte list following the submittal of the work plan. In order to avoid damage to laboratory analytical equipment, the laboratory was notified that the samples may be pure-phase, or high-concentration.

Warehouse 244

As a result of logistical changes, the pure DNT materials in overpack drums were transported from Denova's Rialto facility to PSC's transportation, storage, and disposal facility in Inglewood, California (EPA ID No. CAD008364). The material was shipped from PSC back to Denova's Rialto facility before being sent to the Safety Kleen incinerator facility located in Aragonite, Utah (EPA ID No. UTD 981552177).

Wash 5 Drums

The liquid contents of the overpacked napthalene drum were transported to Denova's Facility in Rialto, California. These materials were transported from Denova to ECDC in East Carbon, Utah, (EPA ID No. UTC 093012201) for incineration and disposal. The overpack drum was transported to ECDC under a separate manifest (Manifest No. 71211) from the manifest used to transport the drum from ANP the Denova Facility in Rialto (Manifest No. 52752). EPA's approval letter provided for transportation to the Safety Kleen incinerator facility in Aragonite, Utah. The material was to be incinerated along with other materials shipped from the Site. The ash residue was to be landfilled in Safety Kleen's nearby facility in Clive, Utah. However, Denova elected to transport the drum to the ECDC facility. This decision by Denova was unknown to ANP until the transfer manifest was received by ANP in June 2000. Hargis + Associates, Inc.(H+A) confirmed with EPA that the ECDC facility has been approved by EPA in accordance with EPA's "Off-Site Rule."

4.8 Removal Action – TNT-contaminated Area

4.8.1 Removal Action

As mentioned in Section 4.7.1, TNT-contaminated soils were discovered subsequent to ESD #1. This area, known as the TNT-contaminated Area, is located within a steep, unnamed arroyo located in the western portion of the ANP site near Pond 4 and west of the active manufacturing area. The area was discovered in August 1997, during a routine surveillance of stormwater runoff. The TNT-contaminated Area consisted of a dark-brown stained soil area, a wafer-like ledge of stained soil and fibrous material protruding from unstained soil, and dispersed miscellaneous debris within the pile of stained soil. The stained soil and debris are believed to have originated from an abandoned explosive salvage operation conducted prior to ANP's acquisition of the property.

Pieces of metal debris, including broken shell casings, small diameter pipes, washers, plugs, and various unidentifiable objects, also were observed intermixed with the stained soil. Analytical results of soil samples collected in September 1997 identified significant concentrations of TNT, as well as lesser quantities of DNT. The TNT concentrations, detected in two samples, ranged in concentrations from 53 to 56 percent by weight. The results of a February 1999 survey, including consultations with various UXO technical experts, concluded that the metal fragments were not UXO and did not pose a risk. In March 1999, ANP conducted additional soil sampling for TNT.

Concentrations of TNT ranged from 620 mg/kg to 560,000 mg/kg. Additional soil samples were collected in June 1999 to determine whether other contaminants were present. This analysis included a screening for pesticides. In August 1999, ANP reported that a trace amount of 4,4-DDE at levels below Arizona's residential SRLs was detected by the laboratory in one sample. Endrin-aldehyde, previously detected in 1997, was not detected in the 1999 analytical results.

On November 8, 1999, a Removal Action Memorandum was issued for the Site. The remediation of the area was proposed for a time-critical removal action as defined in Section 300.415 of the National Contingency Plan, 40 Code of Federal Regulations (CFR) Part 300. If a sufficient volume of runoff collects in the depressions containing the TNT, there is potential for overflow and runoff to nearby washes that are tributaries to the San Pedro River. The San Pedro River is an important natural resource to the State of Arizona. Additionally, this geographic area is prone to extreme storm conditions, including frequent lightening storms, which pose a potential explosion risk. The proximity of the TNT to site employees and production areas of the facility increase the health and safety risk. The facility produces and stores industrial quantities of ammonium nitrate, ammonia, and nitric acid. Explosions in the area could cause damage to containment and process structures which could result in a release of fluids and/or gases to the atmosphere.

The removal action consisted of the following activities related to the removal of 30 tons of TNT-contaminated soils from the Apache Powder Superfund Site:

- Test Burn
- Excavation
- Pretreatment Burn On Site of High Concentration Materials
- Off-site Transport and Incineration (Safety Kleen, Inc., Aragonite, Utah)
- Ash Disposed at Grassy Mountain Landfill (Safety Kleen Landfill in Utah)

The pretreatment burn was necessary because the levels of TNT in some of the soils to be removed could not be safely transported to the Utah facility for incineration without pretreatment. Alternatives to open burning as pretreatment were found to be ineffective. The only viable alternative available was on-site incineration, which was eliminated due to the relatively small amount of soil to be treated and community acceptance considerations. A test burn was specified to ensure that the pretreatment burn activities could be done safely and in compliance with state requirements.

The removal action also specified the following items to ensure that these activities met the substantive requirements of the state of Arizona Air Quality Control Rules and Regulations for emissions from nonpoint sources, including open burns, under Title 18, Chapter 2, Article 6:

- A technical air quality expert, SA & B, will provide consultation expertise on air monitoring and air dispersion modeling, as required by ADEQ.

- Test burn and pretreatment burn to be conducted during the hours of 10:00 am to 2:00 p.m. to comply with Article 6.

- Continuous air monitoring will be conducted throughout the test burn and pretreatment burn for TNT, DNT, trinitrobenzene, total dust, CO, NO, and NO_2.

- Air monitoring and meteorological data collected during the test burn will be used to develop an air dispersion model to project the extent of emissions during the pretreatment burn of high-concentration materials.

- ANP will monitor air quality in accordance with EPA's publication, *Compilation of Air Pollutant Emission Factors* (AP-42).

It was also specified in that document that Arizona SRLs would be used as remedy standards for 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 1,3,5-trinitrobenzene, and DDE.

The community involvement activities conducted prior to the remedial action included:

- EPA Fact Sheet, dated November 1999.

- EPA Community Meeting on November 9, 1999.

- ANP Letter, dated November 5, 1999 to 15 residences within a 1-mile radius.

4.8.2 Implementation of Removal Action

Pre-burn activities were performed in the unused, dry Pond 4B location, located within ANP property boundaries. In accordance with the health and safety procedures outlined by the EPA, prior to pre-burn activities, an exclusion zone boundary was established at the top of the 8- to 10-foot berm surrounding Pond 4B. This provided a minimum setback of 310 feet for all observers.

ANP obtained an open burn permit to conduct the pre-burn activities. As part of this permit, air dispersion modeling was performed by SA&B, in cooperation with ADEQ, for assessment of potential contamination dispersion by the TNT pre-burn activities. The air dispersion modeling was used to develop the health and safety procedures established by EPA for the pre-burn. The open-burn permit restricted burning to between the hours of 10:00 a.m. and 4:30 p.m. Burning activities were to be suspended if lightning was observed, if wind speeds exceeded 25 miles per hour, or if other unfavorable meteorological conditions were anticipated. The open-burn permit further required an observer from ADEQ and the Cochise County Hazardous Materials Response Team to be present during burning.

The final work plan approved by EPA limited the pretreatment to two 1,500-pound loads per day. Actual pretreatment was limited to one load per day based on the time required to prepare the pre-burn loads and cool the burn tray after burning.

Prior to conducting the pre-burn treatment, ANP conducted a test burn of 5 pounds of high-concentration TNT-contaminated material. The test burn was conducted on November 10, 1999 at the ANP facility. The purpose of the test burn was to confirm that on-site safety and air monitoring procedures were appropriate. Additionally, the test burn provided an opportunity to visually document potential air emissions using video and still photography. A sample of the ash material was collected and sent to the SafetyKleen laboratory in Aragonite, Utah for analysis. The laboratory data indicate less than 1 percent organics. One percent organics or greater is the EPA criterion for acceptance of material for incineration.

Air monitoring was also performed during the test burn. Samples were analyzed for TNT, DNT, dinitrobenzene (DNB), trinitrobenzene (TNB), and total hydrocarbons. Very minor amounts of TNT were encountered in the ambient air downwind of the test burn. No other compounds were detected during the test burn. The air monitoring data were used to develop health and safety precautions for the pre-burn.

Excavation of the TNT-contaminated Area was performed in two phases. The first phase involved the excavation and pre-treatment of "high concentration" TNT materials, defined as materials containing greater than 10 percent TNT by weight. Pretreatment was achieved by pre-burning the high concentration TNT materials in a designated pre-burn area. The second phase involved the excavation and off-site transport of the remaining "low concentration" materials. The low concentration materials did not require pretreatment.

During the excavation of the high-concentration TNT materials, the TNT-contaminated Area was wetted down using a mixture of water and detergent to reduce the reactivity of the TNT and help break down any clumps of TNT present in the soil. The high-concentration materials were excavated by hand using non-sparking tools, placed into buckets, and hand transported to roll-off bins located in the pretreatment area in Pond 4B. Each bucket carried approximately 0.50 cubic feet of material. During the period of December 27, 1999 through January 5, 2000 approximately 85 cubic feet of TNT-contaminated materials, weighing approximately 5,400 pounds, were excavated.

Six pre-burns were conducted between December 27, 1999 and January 5, 2000. Burn Number 4 was incomplete and was therefore re-burned as Burn Number 5. Concentrations of TNT remaining in the soil after the pre-burn activities were less than the 1 percent incineration cutoff concentration. Current EPA regulations prevent incinerators from accepting materials containing less than 1 percent of organic compounds. Therefore, all TNT material was directly landfilled without treatment by incineration.

During the period of January 5, 2000 to February 8, 2000, TNT-contaminated soil that did not exceed 10 percent was excavated from the hillside and placed in a stockpile within the TNT-contaminated Area for transportation and disposal. These low-concentration materials were then loaded into roll-off bins and large capacity dump trucks and transported to the disposal facility. During the first excavation, approximately 574 tons of TNT-contaminated soil below 10 percent was excavated for off-site disposal to the landfill operated by U.S. Ecology, Inc. in Beatty, Nevada (EPA ID No. 330010000).

Field verification soil sampling was conducted during excavation using TNT/DNT field test kits based on EPA Method 8515. Additional soil was excavated in areas where field soil samples exceeded the field screening concentration. The final sweep of field samples on February 7, 2000 indicated that TNT soil concentrations were less than the clean-up criterion. Field test kit results were verified with laboratory testing and confirmation soil samples collected on February 16, 2000. These preliminary samples indicated TNT- and TNB-contaminated soil in excess of soil clean-up standards remained in the TNT-contaminated area following the initial excavation.

During the week of June 26, 2000, additional soil from the TNT-contaminated soil area was excavated using a tracked excavator. An additional 295 tons of TNT-contaminated soil were removed during this second round of excavation and transported to U.S. Ecology, Inc. in Beatty, Nevada (EPA ID No. NVD 330010000). Field verification soil samples were collected from three potential problem areas. All three field verification samples were below the field screening concentration.

The removal action implementation report for TNT-contaminated area was issued August 2000.

No O&M activities are required in conjunction with remedial actions for the TNT-contaminated Area.

4.8.3 Modifications to Removal Action Work Plan

The modifications listed below were EPA-approved prior to implementation of the modification.

Post-burned material resulted in organic concentrations lower than the 1 percent EPA requirements for incineration. The post-burned material, therefore, was directly landfilled at U.S. Ecology in Beatty, Nevada instead of being incinerated at Safety Kleen's Aragonite Facility prior to landfilling.

4.9 Summary Status of Cleanup Activities Conducted Under State Consent Decree

As previously mentioned, certain areas of the Site fall under RCRA jurisdiction and have been addressed under ADEQ oversight. The 1994 state CD mandated requirements for the following:

- Brine Concentrator System

- Closure of OBOD Area
- Hazardous Waste Management Requirements
- Nitric Acid Plant and LAN Plant Inspection Requirements
- Explosive Inventory and Disposition
- APP Application Requirements

4.9.1 Consent Decree Requirements Completed to Date

ANP immediately began completion of CD requirements according to the schedule specified.

Construction of the brine concentrator facility was completed December 1994. During April 1995, the brine concentrator began full-scale start up, therefore all industrial wastewater discharges formerly routed to the evaporation ponds were rerouted to the brine concentrator. These respective requirements, pursuant to Section XII of the CD (Paragraph 55) were initiated under EPA jurisdiction and also mandated in the ROD. UAO-1 of 1989 required a source control plan to include wastewater treatment and /or acceptable handling. ANP began developing a source control plan and advised EPA that it intended to utilize a brine concentrator. When EPA issued ANP its second UAO in 1994, EPA required ANP to implement the remedial action alternative set forth in the ROD, in particular the construction of a brine concentrator as a perched water cleanup remedy.

Closure activities for the OBOD area were performed in February 1997. Closure activities included:

- Demolish, load, haul, and dispose of the concrete burn pads and the brick from the burn pads.
- Hand-transfer ash gathered from the pads from 55-gallon drums into a roll-off box. The drums were crushed on site and loaded with the ash.
- Disposal was arranged for at Huachuca Landfill. Materials were hauled in covered roll-off boxes to the Huachuca Landfill and all loads were scaled prior to disposal.
- The contractor watered the Site during demolition and loading to control dust emissions.
- Approximately 4 cubic yards (5 tons) of soil was excavated from four locations. This soil was loaded into a roll-off box, transported, and disposed of at the Huachuca Landfill.
- Fence and debris from the Site was included in the loads to Huachuca Landfill. The Site was rough-graded at the completion of the work, and the Site was sprinkled with water as a dust control measure.

- Characterization and confirmation sampling was performed.

On February 28, 1997, the OBOD Area was closed per Paragraph 9 of the CD.

On November 4, 1998, following a joint petition by ADEQ and ANP, the Court ordered that the hazardous waste provisions of the CD had been satisfied and should therefore be terminated. As a result, only the APP provisions of the CD remained in effect, and of these provisions only the APP requirements identified in Paragraphs 37, 39, 40, 42, and 44 of the CD remained outstanding.

Completed APP Requirements

Wastewater discharge ceased to unlined ponds and was managed by construction of the brine concentrator, closure of some facilities, and construction of individual treatment facilities. By ceasing discharge to unlined ponds, many original requirements of the CD were no longer necessary such as the installation of flow meters and waste stream characterization. The status of APP requirements are discussed below.

Pursuant to Paragraph 36 of the CD, ANP had submitted to ADEQ a "Work Plan for the Installation of Flow Meters" on January 3, 1995; Paragraph 37 of the CD requires implementation of this work plan. In a letter dated December 21, 1998, ADEQ agreed with ANP that the installation of flow meters is no longer necessary in the manufacturing area of the facility since the brine concentrator now receives all wastewater from the plants (including Ammonium Oxidation Plant [AOP]-3, AOP-4, LAN, and the Powerhouse). In addition, ADEQ stated that "the installation of flow meters to monitor the flows from the shops, vehicle washes, and laboratories may not be required either, provided these discharges are also stopped" with the installation of wastewater collection and treatment systems ("vault and recycle" and "separator/evaporator" system), ANP believes all requirements of Paragraph 37 of the CD have now been fulfilled.

Wastestream characterization was no longer necessary given the alternative management implemented at the Site. The combined AOP-3, AOP-4, LAN, and Powerhouse wastestreams are now recycled via the brine concentrator without discharge, therefore it is not necessary to further characterize these wastestreams as stipulated in Paragraph 38 of the CD. Likewise, the construction of the vault and recycle and separator/evaporator systems to collect the Main Laboratory and Maintenance Area discharges eliminated the need to characterize the wastestreams.

Pursuant to Paragraph 40 of the CD, a "Best Available Demonstrated Control Technology (BADCT) Determination for Tank 174" was submitted to ADEQ on January 3, 1985. In June 1999, Tank 174 was replaced with a double-walled, stainless-steel tank meeting BADCT requirements, and an additional soil boring was completed to confirm that fluid from Tank 174 did not leak into the surrounding soil before the tank was replaced.

On January 15, 1999, ANP met with ADEQ's Water Permits Section to discuss completion of the outstanding APP requirements of the CD. Subsequently, ANP and ADEQ agreed to a "limited waiver of fee cap" in order to obtain expeditious closure of the APP provisions of the CD.

ANP has completed the specific requirements of the CD for the most part. There are, however, certain issues which remain as a result of findings from some of the investigations that were required as part of the APP, as well as permitting issues. Certain "formerly active ponds" and some facilities listed on the supplemental APP Questionnaire remain under scrutiny mostly due to levels of soil contamination at the site. ADEQ expects to issue an APP to ANP by end of 2002 which will include a compliance schedule for dealing with remaining soil issues.

4.9.2 Discharge Impact Area (DIA)

The DIA assessment encompassed the manufacturing portions of the Site, namely (as listed in the CD):

- AOP-3 (Ammonia Oxidation Plant – 3)
- AOP-4 (Ammonia Oxidation Plant – 4)
- LAN
- Urea Ammonium Nitrate (UAN) Plant (also known as Fertilizer Plant)
- Tank 174
- Tank 95
- Prill Plant

An initial phase of work under the Field Sampling Plan was performed in 1995 and 1996 and included the completion of eight soil borings and one trench, the collection of four surface soil samples, and the collection of 17 subsurface soil samples in ANP's manufacturing area. The results of this work were submitted to ADEQ in correspondences dated January 24, 1996, March 5, 1996, and May 13, 1998. A final phase of work under the Field Sampling Plan was performed in 1999 and included the collection of 54 discrete surface soil samples and four subsurface soil samples in the manufacturing area of the ANP facility. The results of this work were submitted to ADEQ on November 1, 1999. Surface soil samples were collected from AOP-3, AOP-4, the Cord Laboratory Ditch (also known as the Main Laboratory Ditch and the QA/QC Laboratory Ditch), the Prill Plant, Tank 174, Tank 95, the Rail Loadout Area, the Truck Loadout Area, and the Fertilizer/UAN Plant. Samples were analyzed for Priority Pollutant Metals and nitrogen compounds. In addition, the samples from the truck loadout area were analyzed for total petroleum hydrocarbons (TPH).

In a January 15, 1999 meeting between representatives of ADEQ and ANP, ADEQ indicated that the analytical results from the implementation of the Field Sampling Plan should be compared to the Arizona SRLs. Subsequently, in a February 5, 1999 letter to ANP, ADEQ directed that the analytical results from the implementation of the Field Sampling Plan should also be compared to the Arizona Groundwater Protection Levels (GPLs).

Concentrations of antimony, beryllium, cadmium, copper, nickel, selenium, silver, thallium, zinc, and total nitrogen were below their respective Arizona residential and non-residential SRLs in all samples.

Arsenic was detected at concentrations exceeding the Arizona residential and non-residential SRLs of 10 mg/kg in one or more samples collected from AOP-3, AOP-4, the Prill Plant, Tank 95, and the Fertilizer/UAN Plant. Based on data collected during the preliminary investigation and remedial investigation, the background concentration of arsenic in surficial sediments is 19.2 mg/kg and in the St. David Clay is 38.82 mg/kg. Arsenic concentrations in six surface soil samples collected from AOP-3, AOP-4, the Prill Plant, and the Fertilizer/UAN Plant exceeded the background arsenic concentration of 19.2 mg/kg for surficial sediments. Concentrations in only three of the six samples exceeded the St. David Clay background concentration of 38.82 mg/kg.

Chromium was detected at a concentration exceeding the Arizona GPL of 590 mg/kg in one surface soil sample collected from AOP-4. However, the concentration of chromium in this sample was substantially below the Arizona residential or non-residential SRLs of 2,100 and 4,500 mg/kg, respectively.

Nickel was detected at a concentration exceeding the Arizona GPL of 590 mg/kg in one surface soil sample collected from AOP-4. However, the concentration of nickel in this sample did not exceed the Arizona residential SRL of 1,500 mg/kg and was substantially below the non-residential SRL of 34,000 mg/kg.

Mercury was detected at a concentration exceeding the Arizona residential SRL of 6.7 mg/kg and the Arizona GPL of 12 mg/kg in one surface soil sample collected from AOP-3. However, the concentration of mercury in this sample was substantially below the Arizona non-residential SRL of 180 mg/kg.

Lead was detected at a concentration exceeding the Arizona GPL of 290 mg/kg in one surface soil sample collected from AOP-4. However, the concentration of lead in this sample did not exceed Arizona residential SRL of 400 mg/kg and was substantially below the non-residential SRL of 2,000 mg/kg. Lead was also detected at a concentration exceeding the Arizona residential and non-residential SRLs and the Arizona GPL in one surface soil sample collected from AOP-3.

As previously mentioned, it is known that elevated background arsenic concentrations in soils and groundwater are naturally occurring in the vicinity of the ANP study area. A baseline public health evaluation/ecological assessment, prepared for EPA as part of the Apache

Powder Superfund site CERCLA action, determined that the potential for on- or off-site exposure to arsenic in surface soils is minimal. In addition, extensive subsurface investigations at the Site have determined that a shallow alluvial aquifer is not present beneath the manufacturing area of the Site. Approximately 300 feet of impermeable St. David Clay overlies the deep, confined aquifer. This information suggests that the probability of groundwater contamination from surficial exceedences of the SRL is low.

In short, the soil sampling results, indicated evidence of soil contamination (e.g., arsenic, lead, chromium, nickel, and/or mercury) at:

- AOP-3
- AOP-4
- UAN Plant
- Prill Plant

Upon reviewing the 1999 sample results, ADEQ expressed concerns that there were instances where constituents exceeded the SRLs and GPLs. In addition, ADEQ felt that, in many cases, the horizontal and vertical extent of constituents of interest that exceeded the soil remediation standards was unknown.

ANP discussed supplemental sampling with ADEQ on June 14, 2000. ANP confirmed acceptance of ADEQ comments in a letter dated July 5, 2000. The supplemental Field Sampling Plan was initiated on July 12, 2000. Soil sampling was designed to characterize the horizontal and vertical extent of constituents of interest as identified in March 1999. Where possible, a sample was co-located at the March 1999 sample location to assess consistency between the March 1999 event and the July 2000 event. In addition, leach testing at select sample locations in the manufacturing area was performed. In general, reported soil sampling results for the July 2000 sampling event in the manufacturing area were lower than the sample results reported for the March 1999 sampling event.

AOP-3

Elevated constituent concentrations found in the AOP-3 area are believed to be a result of the welding operations performed at this location. At the time of sampling, portable welding equipment, acetylene tanks, and piping were located at this site.

At the location of the highest reported concentration for a constituent of interest, soil samples were analyzed in 3-inch intervals to evaluate the vertical extent. Concentrations exceeded SRLs to an approximate depth of 9 inches.

Arsenic, lead, and mercury were analyzed for leaching potential. Reported constituent concentrations were at or near the detection limit. With the exception of Sample AOP-3-2, reported concentrations were below Arizona Aquifer Water Quality Standards (AWQS). The leach extract for Sample AOP-3-2 exhibited a lead concentration of 0.06 mg/L which is greater than the AWQS of 0.05.

This area was remediated in 2001 under APP oversight. The impacted area was excavated to a depth of at least 9 inches. Three confirmation samples were collected from the base of the excavation and analyzed for arsenic, lead, and mercury. All analytes were below the Arizona residential SRLs.

AOP-4

Arsenic concentrations exceeded SRLs in an area located on the southwest corner of the AOP-4 Nitric Acid Plant Facility. Sampling activities in this area were limited to a depth of 3 inches due to the high degree of consolidation/compaction observed below the ground surface.

A second area located midpoint on the southeast side of the AOP-4 facility was evaluated for arsenic, chromium, nickel, and lead.

All constituents were below SRLs. Chromium, nickel, and lead were analyzed to evaluate the leaching potential of these metals. Leachable metal concentrations were below AWQS.

UAN

The area on the southwest side of the UAN facility was evaluated. All constituents were below SRLs.

Prill Plant

The area on the south side of the Prill Plant was evaluated. Samples were analyzed for total arsenic and lead concentrations. Arsenic and lead concentrations were below SRLs.

Further Action

No further actions are currently underway. However, future activities may be mandated should the results of the state human health risk assessment (for arsenic) or the SLERA, both of which are currently in progress, indicate that such actions are necessary.

4.9.3 Facility Closures

Paragraphs 41 and 43 of the CD mandated the closures of:

- Carbamite Manufacturing Facility,
- Detonating Cord Manufacturing Facility,
- Laundry Facility, and
- Active Ponds (also known as Formerly Active Ponds).

Pursuant to Paragraph 41 of the CD, ANP submitted to ADEQ for approval the *Detonating Cord Manufacturing, Carbamite Manufacturing, and Laundry Facilities Closure Plan,* dated March 1, 1995. Pursuant to Paragraph 43 of the CD, ANP submitted to ADEQ for approval the *Active Ponds Closure Plan*, dated March 1, 1995. ANP began closure activities at the facilities in 1994 and 1995. In March 1999, surface soil sampling was performed at the three facilities and ponds.

The following sections describe the closure activities completed pursuant to Paragraphs 42 and 44 of the CD. Based on the completion of the work described below at the Carbamite Manufacturing Facility, Detonating Cord Manufacturing Facility, and Laundry Facility, all requirements set forth in the closure plan and Paragraph 42 of the CD have been fulfilled.

Carbamite Manufacturing Facility

As discussed in the closure plan, ANP began closure activities at the Carbamite Manufacturing Facility after production of Carbamite products ceased in mid-1995. The remaining inventory of materials was reused by ANP on site, recycled, or disposed of as non-hazardous waste. In 1997, the diesel storage tank was removed, and the pipelines were partially removed and capped.

On March 5, 1999, surface soil samples were collected in the vicinity of the Carbamite Manufacturing Facility. Samples were collected west of the building where materials were handled and east of the building beneath the former diesel storage tank and related pipelines. All samples were analyzed for TPH, ethylbenzene, nitrate as nitrogen, and xylene.

Concentrations of all analytes were less than Arizona residential SRLs with the exception of TPH. TPH was detected at respective concentrations of 21,000 and 6,900 mg/kg in two samples collected from beneath the former diesel fuel storage tank and pipelines. On the basis of these results, ANP excavated approximately 250 cubic yards of TPH-impacted soil from the Carbamite Manufacturing Facility. The soil was then stockpiled until analytical results of samples confirmed that TPH concentrations were less than the Arizona residential SRL of 4,100 mg/kg. During the period from January 5 through 7, 2000, the soil stockpile was loaded and transported to a low-temperature thermal desorption treatment facility near Vicksburg, Arizona.

Detonating Cord Manufacturing Facility

ANP began closure activities at the Detonating Cord Manufacturing Facility after production of detonating cord ceased in April 1994. Clean-up operations at the facility were conducted during the period of April through September 1994. Clean-up operations included washing the interior floors and walls of each building with water. The washwater was filtered and discharged into adjacent Pond 9. The remaining inventory of materials was reused by ANP on site, sold back to vendors, recycled, or disposed of as non-hazardous waste. In June 1999, all pipelines at the facility were abandoned in place by capping at the discharge points and filling with a sand-cement slurry.

On March 5, 1999, surface soil samples were collected in the vicinity of the Detonating Cord Manufacturing Facility. Samples were collected at 50-foot intervals in the unlined ditch along the north and east sides of the facility. In addition, two surface soil samples were collected from beneath the Mix House and Drying Room #2 concrete foundations. These samples were collected pursuant to an inspection of the buildings that revealed cracks in the concrete foundations. One subsurface soil sample was collected adjacent to the Maintenance Shop. This sample location was selected based on its location in an area where equipment was historically degreased. With the exception of the Maintenance Shop sample, samples were analyzed for nitrate as nitrogen and pentaerythritol tetranitrate (PETN). The subsurface soil sample from the Maintenance Shop area was analyzed for ethylbenzene and VOCs.

Concentrations of nitrate as nitrogen in all samples were below the Arizona residential SRL of 100,000 mg/kg. Concentrations of PETN in all samples were below the residential health-based guidance level of 33,250 mg/kg. Ethylbenzene and VOCs were not detected in the sample collected from the Maintenance Shop area.

Laundry Facility

As discussed in the Closure Plan, ANP conducted closure activities at the Laundry Facility in September 1994. Cleanup operations included washing the interior floors and walls of the building with water. The washwater was discharged into the Laundry Pond. The remaining inventory of materials was reused by ANP on site.

Active Ponds

Closure activities relating to the Active Ponds were completed pursuant to Paragraph 44 of the CD. The Active Ponds include Ponds 1A, 1B, 2A, 2B, 3A, 3B, 9, 9A, 9B, the Laundry Pond, and the Prill Wash. Despite the fact that these ponds have not been in use since early 1995, pursuant to the closure plan, the ponds were inspected and surface soil samples were collected on March 3 and 4, 1999. A minimum of three surface soil samples were collected from each pond. Samples were analyzed for antimony, arsenic, barium, beryllium, chromium, lead, manganese, and nitrate as nitrogen. In addition, samples collected from Ponds 9, 9A, 9B, and the Laundry Pond were analyzed for PETN.

Concentrations of antimony, barium, beryllium, chromium, lead, manganese, nitrate as nitrogen, and PETN were equal to or below their respective Arizona residential SRLs in all samples collected from Ponds 9, 9A, 9B, the Laundry Pond, and the Prill Wash. Arsenic was detected at concentrations exceeding the Arizona residential and non-residential SRL of 10 mg/kg in samples collected from Ponds 1A, 1B, 2A, 2B, 3A, and 3B. However, arsenic concentrations did not exceed the Arizona GPL of 290 mg/kg.

As mentioned previously, the preliminary investigation and remedial investigation indicated that the background concentration of arsenic in surficial sediments is 19.2 mg/kg and in the St. David Formation is 38.82 mg/kg. Arsenic concentrations in 12 samples collected from Ponds 1A, 1B, 2A, 2B, and 3A exceeded the background arsenic concentration of 19.2 mg/kg for surficial sediments. Concentrations in only eight of the 12 samples exceeded the St. David Clay background concentration of 38.82 mg/kg.

It is known that regional elevated arsenic concentrations in soils and deep aquifer groundwater are naturally occurring. Levels of arsenic in deep aquifer groundwater have been detected at concentrations up to 0.038 mg/L. Arsenic was detected in a sample collected from ANP Well No. 1 at a concentration of 0.036 mg/L. Given that arsenic is known to exist at high background levels in the St. David Formation and in deep aquifer groundwater, and that deep aquifer groundwater is used by ANP in its processes, it is conceivable that naturally-occurring arsenic may have concentrated and precipitated in the former evaporation ponds. Generally, arsenic is not detected above the method detection limit of 0.005 mg/L during groundwater monitoring activities. On occasion, arsenic has been detected in samples but in concentrations substantially below the federal primary MCL and Arizona Safe Drinking Water standard of 0.05 mg/L.

Beryllium was detected at concentrations exceeding the Arizona residential SRL of 1.4 mg/kg in three samples collected from Ponds 2B and 3B. However, concentrations in these samples did not exceed the Arizona non-residential SRL of 11 mg/kg. Beryllium has not been detected in perched zone, shallow aquifer, or deep aquifer groundwater above the method detection limit of 0.01 mg/L. In addition, beryllium was not detected in the water samples collected from the evaporation ponds during the remedial investigation.

In March 1999, ANP conducted sediment sampling in the formerly active ponds to characterize the vertical extent of previously observed soil impacts.

Sample locations were co-located with the March 1999 sample locations; however, based on sampling objectives, the sample depth intervals in July 2000 were significantly different. In March 1999, the sample interval was 0 to 3 inches below the existing ground surface. In July 2000, the sample intervals extended to the bottom of each pond. Specifically, the three inches of sediment above the bottom of the natural clay liner was sampled. In addition, samples from the natural clay liner were also collected.

The sampling results indicated:

- Pond 1A Arsenic concentrations exceeded background in the sediment samples taken at the three discrete locations. The average depth of sediment, calculated from the three sampling points, is approximately 2.7 feet.

- Pond 1B Arsenic concentrations exceeded background at sample point 1B-1. The estimated depth of sediment at this location was 6.75 feet.

- Pond 2A Arsenic concentrations exceeded background in the sediment samples taken at three discrete locations. Average depth of the sediments is 2.35 feet.

- Pond 2B Sediments were sampled for beryllium at two discrete locations and for arsenic at one location. Beryllium concentrations were below minimum reporting limit. The arsenic concentration exceeded background. The depth of sediment was approximately 0.3 feet at this location.

- Pond 3A Arsenic concentrations exceeded background at all sampling points. Depth of the sediment varied across the length of the pond. At 3A-1, the sediment depth was 3.6 feet. At the center and southern sampling points, the liner depth was less than 0.6 feet.

- Pond 3B Beryllium concentrations were analyzed at the midpoint location of the pond. Beryllium concentrations were below minimum detection at this location; therefore, no further action is proposed.

Further activity at the Active Ponds has been postponed until the completion of the ecological risk assessment. Any decisions made will be consistent with those made for the Inactive Ponds.

4.9.4 Supplemental APP Questionnaire

The CD required APN to answer a questionnaire in Appendix B of the CD. APN was required to provide a narrative describing the operating processes of the facilities listed, including information regarding the materials used in the process, wastes and wastewater generated during the process, methods of disposal of the wastes and wastewater generated, and any pollution mitigation measures used for BADCT. The areas listed included:

- PETN Detonator Cord Manufacturing
- Safety Fuse Manufacturing
- Carbamite Manufacturing
- Laundry
- Laboratories
- Pickling Laboratory
- Maintenance Shops (Tree-line Ditch)
- Explosives Testing Area

APN was also required to provide information on drum storage areas, construction debris (Construction Debris Landfill), and material in the borrow pit/landfill (borrow pit/barrow pit). A report was issued in 1995 that addressed all of these areas. Only four areas required further investigation:

- PETN Detonator Cord Manufacturing (Detonating Cord Manufacturing Facility)
- Carbamite Manufacturing
- Laundry
- Tree-line Ditch

The Detonating Cord Manufacturing Facility, Carbamite Manufacturing, and Laundry were investigated and closed as described in Section 5.1.

Sampling was performed on March 1999 at the Tree-line Ditch. Subsurface soil samples collected from the Tree-line Ditch were analyzed for VOCs and TPH.

Sampling at the Borrow Pit was performed in July 2000. Three 0- to 3-inch samples were taken in the Borrow Pit Area. A sample was taken at the deepest point in the pit where water was likely to accumulate. Two additional samples were taken at opposite locations of the deepest point, at a point three-quarters the distance to the edge of the pit. Samples were analyzed for total arsenic and were evaluated using synthetic precipitation leaching procedure (SPLP). Analytical results for arsenic were below SRLs for the east and center locations. Arsenic concentration exceeded the SRL (24.9 mg/kg soil) at the west location. The SPLP results for arsenic were below the minimum reporting limit (0.04 mg/L).

Additional activities may be required. However, this work will not be determined until the completion of the ecological risk assessment.

4.9.5 Facility Identified in the 1993 ADEQ Site Inspection

In addition to the areas that were identified in the CD, there were other areas that ANP was required to address in order to obtain their permit from APP. On May 21, 1993, the APP of ADEQ conducted a site inspection due to concerns about inadequate submittals and possible additional discharge. The following areas were specifically identified in a letter dated April 19, 2000.

- Drainage area south of Prill Barns
- Ditches at QA/QC Lab
- Drainage from Prill Lab
- Cesspool at Works Lab
- Drainage at Maintenance Shops
- Drainage from Welding Shop
- Ditch between Lime Settling Basin and Pond 2A
- Power House Cooling Tower Injection Well
- Cooling Tower Ditch

In a report dated October 2000, ANP determined that all of these areas had been adequately investigated and addressed except for the Cooling Tower Ditch. Additional sampling was performed in July 2000. The area was determined to be impacted by arsenic.

The area was remediated in 2001. The impacted area was excavated to a depth of at least 6 inches. One confirmation sample was collected from the base of the excavation and analyzed for arsenic. The level of arsenic in the confirmation sample was below the Arizona residential SRL.

4.9.6 Leaking Underground Storage Tanks

This section provides information on the leaking underground storage tanks (LUSTs) located on the Site. LUSTs were not addressed in the CD. The LUSTs are under the jurisdiction of the ADEQ's LUST program. They have been included in this section because these areas are located in the proximity of areas covered under the CD and the ROD and because they are under ADEQ oversight. Two LUST sites are located on the Site: Tank 109 Site and Filling Pumps Site (Figure 15).

Tank 109

The Tank 109 site is located in the north-central portion of the ANP Manufacturing Area. This location had a single tank formerly used for gasoline. The installation date of the tanks is unknown; the tank was removed January 30, 1990.

Prior to backfilling the UST excavation on January 30, 1990, two soil samples were collected from approximately 11 feet bls (4 feet below the bottom excavation surface) and chemically analyzed for TPH and benzene, toluene, ethylbenzene, and total xylenes (BTEX). The analyses indicated that the soil samples contained detectable concentrations of TPH and BTEX. The excavation was backfilled on January 30, 1990, with a mixture of clean soils excavated from the Tank 109 Site and imported fill by A-1 Equipment Company.

To further characterize the extent of the gasoline release at the Tank 109 Site, five soil borings (GT-1 through GT-5) were drilled during March 21 and 22, 1990. Soil boring GT-1 was located at the approximate center of the former UST excavation. Soil borings GT-2 through GT-5 were located north, south, east, and west of the soil boring GT-1, respectively. Total depths of the soil borings ranged from 34.5 to 53.5 feet bls. A total of eight samples were collected from these borings for chemical and physical analysis. The results of the investigation indicated that soils that contained residual gasoline appeared to be limited to an area 15 to 18 feet in diameter and 40 feet deep, centered at the former location of Tank 109.

A total of nine soil borings (RGT-1 through RGT-9) were drilled to define the vertical and horizontal extent of the release during an additional investigation performed October 17 through 25, 2000. Soil samples were collected for lithologic logging and laboratory analysis. Soil borings RGT-1 through RGT-4 were drilled next to former soil borings GT-1 through GT-4, respectively, to facilitate re-sampling and analysis of subsurface soils at these locations. ADEQ did not require a re-drilling of former soil boring GT-5.

Based on field observations and results of mobile laboratory analytical results for soil boring RGT-2, additional soil borings RGT-5 through RGT-9 were drilled at locations generally north of the former Tank 109 UST location. Analytical results for the Tank 109 2000 site characterization indicate that soils containing benzene concentrations greater than ADEQ non-residential SRLs are located in the vadose zone underlying the immediate vicinity of the former UST location and a nearby former loading dock. These concentrations are limited to the upper clayey unit underlying the Site, to an approximate depth of 23 feet bls.

Based on the results of the 1995 and 2000 site characterization events, approximately 180 cubic yards of soils containing BTEX concentrations greater than non-residential SRLs underlie the former locations of Tank 109 and loading dock.

Closure of this site is contingent upon the ecological risk evaluation currently in progress under EPA's jurisdiction.

Filling Pumps Site

The Filling Pumps at the Site are located in the center of the Manufacturing Area. This location had four tanks: two diesel tanks and two gasoline tanks. The installation dates of the tanks are unknown; the tanks were removed on March 2 and 3, 1995.

Based on observations of the integrity of the USTs and condition of the soils in the excavations, eight soil samples were collected from locations likely to contain TPH and/or BTEX. Two samples were collected from the native soil at the bottom surface of each excavation. The four soil samples collected from the excavations for diesel USTs AP-1 and AP-2 were analyzed for TPH, and the four soil samples collected from the excavations for gasoline USTs AP-3 and AP-4 were analyzed for TPH and BTEX. The analytical results indicated that petroleum hydrocarbons and/or BTEX constituents were detected in the soils forming the bottom surface of the excavations for UST AP-1, AP-3, and AP-4.

Two soil borings were drilled at the Filling Pumps Site to define the vertical extent of the release on October 17, 2000. Soil samples were collected for lithologic logging and laboratory analysis. Soil boring AP1-1 was drilled at the former location of diesel UST AP-1 and soil boring AP3-1 was drilled at the former location of gasoline UST AP-3. The total depth of each boring was 20 feet bls.

Groundwater was encountered in soil borings AP1-1 and AP3-1 at approximately 10 and 17 feet bls, respectively. It is believed that the groundwater encountered in soil boring AP1-1 was actually located within the excavation backfill material on top of the underlying St. David Clay. This is because groundwater was observed between 10 and 12 feet bls, but was not present in the borehole during collection of soil samples from 15 to 20 feet bls. In accordance with the ADEQ *LUST Site Characterization Manual*, a groundwater sample was not collected from this soil boring because the groundwater is believed to be located within excavation backfill material above the lithologic interface with the underlying native St. David Clay. The groundwater encountered in boring AP3-1 is believed to be a remnant of the perched groundwater zone. No detectable concentrations of the analytes were present in the soil samples collected from either soil boring, thus additional soil borings were not drilled at these sites. Groundwater was sampled from soil boring AP3-1 and chemically analyzed for the analytes.

Analytical results for the Filling Pumps Site soil samples collected during the 1995 site characterization indicated that soils that contained TPH concentrations greater than ADEQ non-residential SRLs were limited to clayey vadose soils comprising the bottom surfaces of the UST AP-3 and AP-4 excavations, approximately 12 feet bls. BTEX and TPH were not detected in soil samples collected from soil borings drilled during the 2000 site characterization activities. A groundwater sample collected from one of the borings during the 2000 site characterization activities indicates detectable concentrations of ethylbenzene and total xylenes less than Arizona AWQS.

If soils containing TPH or BTEX concentrations greater than non-residential SRLs are still present at the Filling Pumps Site, they are most likely limited to isolated portions of the excavations of former USTs AP-1, AP-3, and AP-4. The Filling Pumps Site was closed April 2, 2001.

5.0 Five-year Review Findings

The following sections discuss findings from the five-year review.

5.1 Five-year Review Process

The Apache Powder five-year review was led by Andria Benner, the EPA's remedial project manager for the Site. EPA received technical support from CH2M HILL. ANP and ADEQ were notified on April 11, 2002 of the initiation of this review.

The five-year review consisted of the following activities: a review of relevant documents (see Appendix A); a regulatory review; and a site inspection. Interviews were not conducted as part of this review.

Following the release of this document, EPA will produce and distribute a fact sheet to the community near the Site. The fact sheet will summarize the findings of the five-year review and instructions on how to access a copy of the review.

5.2 Document Review

As a part of the five-year review process, CH2M HILL conducted a brief review of numerous documents related to site activities. The documents chosen for review primarily focused on actions that have occurred during the past five years, but ranged in publication date from 1989 to the present. Appendix A provides a list of the documents cited in this report.

5.3 Regulatory Review

This section provides a review of applicable or relevant and appropriate requirements (ARARs) and other standards to be considered (TBCs) for the selected remedy at the Apache Powder Superfund Site. "Applicable" requirements are standards and other substantive environmental protection requirements promulgated under federal and state law that specifically address a circumstance at a CERCLA site, such as a hazardous substance, pollutant, contaminant, remedial action, or location. "Applicability" implies that circumstances at the Site satisfy all jurisdictional prerequisites of a requirement. "Relevant and appropriate" requirements are standards and other substantive environmental protection requirements promulgated under federal or state law that address situations sufficiently similar to a CERCLA site to be of use. "Relevance" implies that the requirement regulates or addresses situations sufficiently similar to those found at the CERCLA site.

"Appropriateness" implies that the circumstances of the release or threatened release are such that use of the standard is germane. TBCs are non-promulgated federal or state advisories or guidelines that are not legally binding and do not have the status of ARARs. However, TBCs may play an important role in the development of site-specific cleanup standards.

The ARARs presented in the ROD signed on September 30, 1994 were reviewed for any changes, additions, or deletions. Two ESDs issued on April 16, 1997 and September 28, 2000 were also reviewed to identify any changes to ARARs identified in the ROD. Any findings that differ from the ROD and ESDs are explained.

5.3.1 Chemical-specific ARARs and TBCs

Table 5-1 presents the updated chemical-specific ARARs and TBCs for water, arranged by contaminated media and chemical compound. The Safe Drinking Water Act (SDWA) MCLs are based on human consumption of water for drinking, cooking, bathing, etc. Economic considerations and technical feasibility of treatment processes are included in the justification for these levels. MCLs are applicable to drinking water at the tap pursuant to the SDWA, and are ARARs for treated water when the end use is drinking water. No MCLs relevant to COCs at this site have changed since the signing of the ROD.

ADEQ Aquifer Water Quality Standards (ADEQ MCLs) established pursuant to ARS Section 49-223 are identical to SDWA MCLs for the compounds detected in groundwater at the Site. No ADEQ MCLs relevant to COC at this site have changed since the signing of the ROD.

ADEQ Health-based Guidance Levels (HBGLs) for groundwater are TBCs for the Site. The HBGLs are derived from calculations based on ingestion of groundwater. The HBGLs have not been promulgated. Nonetheless, ADEQ HBGLs were selected as clean-up standards only for chemicals for which no SDWA MCLs existed. ADEQ Human- and Health-based Guidance was updated in December 1997. Since EPA added perchlorate after its discovery in the shallow aquifer groundwater in November 1998, and no federal MCL exists for perchlorate, the HBGL for perchlorate has been identified as a TBC for this site.

Table 5-1 Comparison of EPA Selected Groundwater Clean-up Levels and Current ARARs and TBC
Apache Powder Superfund Site

Media Component	Chemicals of Concern	1994 ROD selected clean up levels (mg/L)	ARARs		TBC
			SDWA MCL[a] (mg/L)	Arizona Aquifer[b] Quality Standards (mg/L)	Arizona[c] HBGLs for Drinking Water (μg/L)
Perched Groundwater	Arsenic Fluoride Nitrate-N Perchlorate[d]	0.05 4.0 10.0	0.05 4.0 10.0	0.05 4.0 10.0	 14
Shallow Aquifer Groundwater	Arsenic Fluoride Nitrate-N Perchlorate[d]	0.05 4.0 10.0	0.05 4.0 10.0	0.05 4.0 10.0	 14

a. 40 CFR 141 and 40 CFR 143
b. AAC R18-11-406
c. Health-based Guidance Levels for Perchlorate, ADHS, May 2000.
d. EPA added perchlorate as a chemical of concern after its discovery in the shallow aquifer groundwater in November 1998.

Table 5-2 presents the updated chemical-specific ARARs and TBCs for soil, arranged by chemical compound. The 1994 ROD-selected clean-up levels were updated in ESD #2 document issued on September 28, 2000. These updated clean-up levels are listed here. ADEQ also adopted SRLs for residential and non-residential areas in March 1996 by emergency action effective March 29, 1996. These emergency rules were permanently adopted effective December 4, 1997. These soil clean-up levels for each COC are listed in the Table 5-2.

ADEQ does not use HBGLs for the ingestion of contaminants in soils since adoption of these rules. No TBCs were identified for soil clean-up levels.

The ROD clean-up levels exceeded Arizona residential SRLs for two compounds: lead and 2,4-DNT. However, the ROD clean-up levels are below the non-residential SRLs. Also, additional investigations have shown that lead is not a COC at this site.

The 1994 ROD and residential SRL for 2,4-DNT are 140 mg/kg, and 130 mg/kg, respectively. However, confirmation samples for the two areas impacted by 2,4- DNT (Media Components 5 and 7) do not exceed 95.52 mg/kg.

Table 5-2 Comparison of EPA Selected Soil Clean-up Levels and Current ARARs and TBC
Apache Powder Superfund Site

Media Component	Chemicals of Concern	1994 ROD selected clean up levels (mg/L)	2000 ESD selected clean up levels (mg/kg)[a]	Arizona Residential SRLs (mg/kg)[b]	Arizona Non-residential SRLs (mg/kg)[b]
Inactive Pond Soil and Sediment (Media Component 3)	Antimony		31	31	680
	Arsenic		19.23	10	10
	Barium		5300	5300	110000
	Beryllium		1.4	1.4	11.0
	Chromium (total)		2100	2100	4500
	Lead		400	400	2000
	Manganese		3200	3200	43000
	Nitrate-N		100000	100000	1000000
White Waste and Drum Storage Area (Media Component 4)	Nitrate-N	190000		100000	1000000
	Arsenic		38.8	10	10
	Vanadium	820		540	12000
	Vanadium Penta-oxide	1100		690	15000
Wash 3 Area (Excluding OBOD Area) (Media Component 5)	2,4-Dinitrotoluene	140		130	1400
	2,6-Dinitrotoluene	28		65	680
	Hydrocarbons (C10-C32)		4100	4100	18000
	Lead	500		400	2000
Dinitrotoluene Drums Located Outside of the Wash 3 Area (Media Component 7)	2,4-Dinitrotoluene	140		130	1400

Notes:
a. Apache Superfund Site – Explanation of Significant Differences #2, September 28, 2000
b. A.A.C. Title 18, Chapter 7, Article 2, Appendix A

5.3.2 Location- and Action-specific ARARs and TBCs

Table 5-3 presents the updated action-specific ARARs and TBCs for the Site. Changes in local, state, and federal rules and regulations were reviewed to determine whether the changes suggest a question of the protectiveness of the remedy at the Site. Table 5-3 provides the action, requirements, prerequisites, citations, and comments in the ROD for each ARAR and TBC with revisions, if applicable. The table also updates ARARs from the original ROD.

Table 5-3 Potential Action-specific ARARs
Apache Powder Superfund Site

Action	Citation	Requirement Description
Groundwater Pumping	A.R.S. § 49-224 A.A.C. R18-11-407 A.R.S. § 49-282	Classifies the shallow aquifer as a drinking water aquifer; a remedial action may exceed water quality standards if approved by state.
	A.R.S. § 45-454.01	Exempts remedial actions from requirements of A.R.S. 45-401 et. Seq. If water is withdrawn, treated, and reinjected on site. Must comply with certain well drilling and construction standards. Groundwater which is not reinjected must be put to a reasonable and beneficial use.
Discharges to Surface Waters	33 United States Code (USC) § 1342	Must comply with substantive National Pollutant Discharge Elimination System requirements for discharge of treated ground water to navigable waters of the United States.
	33 USC § 1344	Standards for management and protection of wetlands. These standards would not apply to the constructed wetlands as long as the wetlands are used as treatment units. The substantive provisions could become applicable if the constructed wetlands remain after treatment is completed. All provisions including state technical requirements could apply to habitat created off-site.
	A.R.S. § 49-222 A.A.C. R18-11-405.B A.A.C. R18-11-107 A.A.C. R 18-11-108	Discharges to surface waters must meet Arizona surface water quality standards and not cause degradation of existing water quality. Discharges to surface waters shall meet Narrative water quality standards.
	A.A.C. R18-11-102	Surface water standards do not apply to constructed wetlands which are part of a waste treatment system.
	A.A.C. R18-11-105	Discharges to unlisted tributaries to a listed surface water must meet specific standards.
	A.A.C. R18-11-106	The Director may modify a water quality standard if there is a net ecological benefit associated with a discharge.
	A.A.C. R18-11-114	The Director may establish a mixing zone in a surface water body for discharges to that body.
	A.R.S. § 49-283.01	A provider or user of "remediated " water generally is not liable for using the water. The term "remediated water" includes water which is distributed, transported or used in connection with a CERCLA remediation.
Use of Pumped Groundwater for Agricultural Irrigation	A.R.S. § 12-820.09	Defines water used in a CERCLA remedial action as reasonably safe and fit for agricultural use.
Identification of Hazardous Wastes	40 CFR Part 261	Wastes must be managed as hazardous wastes if they are listed wastes or exhibit a hazardous waste characteristic; RCRA "empty" containers may be managed as non-hazardous wastes.

Table 5-3 Potential Action-specific ARARs Apache Powder Superfund Site		
Action	**Citation**	**Requirement Description**
Off-site Treatment/Off-site Disposal of Hazardous Waste	40 CFR Part 268	Hazardous waste or hazardous waste contaminated soils subject to the LDRs must meet applicable treatment levels in Part 268 for each hazardous constituent.

Table 5-4 presents the updated location-specific ARARs and TBCs for the Site. Changes in local, state, and federal rules and regulations were reviewed to determine whether the changes suggest a question of the protectiveness of the remedy at the Site. Table 5-4 provides the action, requirements, prerequisites, citations, and comments in the ROD for each ARAR and TBC with revisions, if applicable.

Table 5-4 Potential Location-specific ARARs Apache Powder Superfund Site		
Location	**Citation**	**Requirement Description**
Floodplain Areas	EO 11988, Protection of Floodplains (40 CFR 6, Appendix A) A.R.S. § 48-3601 et seq.	Remedial actions occurring in a floodplain should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values. The eastern portion of the Apache Powder Site is within the San Pedro River Basin and, therefore, is within the 100-year floodplain. Remedial actions should reflect consideration for flood hazards and floodplain management.
Areas where action may cause irreparable harm, loss, or destruction of significant artifacts	National Archeological and Historical preservation Act (16 USC §469 et seq.); 36 CFR Part 65	Requirements to take action to recover and preserve artifacts if remedial action threatens significant scientific, prehistoric, historic, or archaeological data. No known scientific, prehistoric, or historic artifacts are present at the ANP site.
	National Historic Preservation Act Section 106(16 USC § 470 et seq.); 36 CFR Part 800	See above.
Critical habitat upon which endangered or threatened species depends	Endangered Species Act of 1973; Section 7 (16 USC § 1536); 50 CFR Part 402	Must make a determination of endangered or threatened species and take appropriate action to conserve these species, including consultation with the U.S. Fish and Wildlife Service as required.
Areas with streams or rivers	Fish and Wildlife Coordination Act (16 USC § 661 et seq.); 40 CFR 6.302	Requires consultation with Department of Fish and Wildlife prior to any action that would alter a body of water in the United States. This requirement could be applicable to any action that would result in modification of the San Pedro River.

Table 5-4 Potential Location-specific ARARs Apache Powder Superfund Site		
Location	**Citation**	**Requirement Description**
San Pedro River, from Curtis Station to Benson	AAC, Title 18, Chapter 11, Section 109f (R18-11-109f)	The San Pedro River, between Curtis Station and Benson, has a special numeric Water Quality Standard of 10 mg/L as a single sample maximum for total nitrate as nitrogen.
San Pedro River and Tributaries	R18-11-109 and Appendix B	The San Pedro River (from Mexican border to Reddington) has the following designated uses Aquatic and wildlife (warm water fishery), full body contact, fish consumption, Agricultural Irrigation and agricultural livestock watering. Discharges into the San Pedro River must be protective of all designated uses. This rule also prescribes specific water quality standards for total phosphorus, total nitrogen and limits on discharges of total phosphates for San Pedro River.

5.4 Site Inspection

Representatives of EPA, ADEQ, ANP, ADWR, H+A, Humbolt State University (HSU) and CH2M HILL took part in a site inspection on May 8 and May 9, 2002 with lesser participants. The inspection included all media components, specifically: the NARS; the areas encompassing the shallow and perched southern aquifers; all Inactive Ponds; the White Waste Drum Storage Area; Wash 3 Area; DNT drums outside of Wash 3 Area; TNT-contaminated Area; and San Pedro surface water. A summary of the inspection findings is presented below. In addition, site areas covered under the state CD were also observed. The Site inspection checklist, meeting summary, and photos area provided in Appendix D.

Conditions during the inspection were favorable, with high temperatures and no precipitation. Precipitation had not occurred at the Site recently and vegetation was sparse, which facilitated inspection of all areas.

The status of trespasser control and fencing is discussed for each media component, including individual ponds and other contaminated areas. With the exception of the subsurface groundwater plume and the San Pedro River, all areas of known contamination are located within the property boundaries of the ANP facility, which is fenced at the perimeter.

5.4.1 Media Component 2B Treatment Facility: NARS

During the Site visit the NARS was transitioning between the establishment phase and limited-scale startup (Photos 21 through 24). At the time of the Site visit, neither groundwater extraction nor wetlands discharge was occurring. Inspected portions of the piping delivery and return system were in good condition, with no visible leaks or cracking. Modifications of piping to allow for multiple transfer points of treatment water within cells were recently completed but not yet operational. The new piping appeared to be in good condition. The artificial carbon source was stored on pallets covered with tarps near the primary denitrification area south (Photo 21). At the time of the Site visit, preparations were underway for the installation of a solar-powered recirculation pump.

Cattail plant density throughout the denitrification areas appeared to be at a maximum, indicating a viable carbon source (Photo 22). Sections of cattail had been cut to increase available carbon and the remaining population appeared dense and healthy. Continuation of this activity would appear to provide benefit to the wetlands treatment system. Potamogeton, wetlands vegetation, was present in the ANA cell; however, due to the increase of stage height, health and density cannot be directly reported. Fauna was abundant within the ANA, which probably is the source of the recent E. coli and fecal coliform concentrations within this cell. Pest (caterpillar) infestation did not appear to be an issue at the time of the Site visit; however, the predominant season for infestation is summer.

Minimal surface erosion was present on exposed cell banks (Photo 24). While the bare banks were recently hydroseeded and plans are underway for irrigation with wetlands water, it is not anticipated that this will be adequate to control bank erosion under high-intensity, short-term storm events. An evaluation of cell bank erosion control measures may be necessary following such an event, particularly given the intense management of this issue throughout establishment.

Current health and safety plans and O&M manuals were readily available within the ANP library for field staff. The O&M manual is currently under revision to reflect recent changes in limited-scale and full-scale startup. Water safety rescue equipment was readily available within the wetlands complex.

5.4.2 Media Components 1, 2B, 3, 4, 5, 7, 8

Media Component 1 (the perched groundwater aquifer) is beneath the vicinity of formerly active ponds 1A, 1B, 2A, 2B and the current operations area, trending southeast. All formerly active ponds that may influence Media Component 1, which are managed under the state CD, were dry at the time of the Site inspection. Ponds 1A and 1B were adequately fenced, with approximately 30 percent vegetation coverage and a low level of metal debris scattered throughout the ponds. Ponds 2A and 2B were adequately fenced with no established vegetation and a white powder residue covering the soil surface. Areas pertaining to Media Component 2B (southern shallow aquifer) are similar to that of Media Component 1 given the direct link of recharge via the Apache Wash Paleochannel. Dense scrub was present throughout the area encompassing Media Component 2B.

Media Component 3 includes inactive Ponds 4A, 4B, 5A, 6A, 6B, 7, 8, and the Dynagel Pond, none of which were fenced. These ponds are natural drainage basins adjoining washes used for wastewater disposal during production. Pond 4A and 4B appeared similar to the natural surrounding landscape yet with minimal vegetation cover (approximately 20 percent). At Pond 4B there was no evidence of residual staining on the surface from the pretreated TNT soil (Photos 7-9). The only observed remnant of this remedial activity was the exposed eroding slope as the side walls of this pond were knocked down in 2000. Ponds 5A, 6A, and 7 were covered with approximately 25 percent vegetation which appeared healthy (Photos 10 and 18). Pond 8 supported minimal vegetated cover, surrounded by a gentle berm to the north that leads to the steep eroded slope encompassing Wash 5 (Photos 13-15). Adjacent to Pond 8 were remnants of a warehouse or production area containing boxes used to transport explosives during operations. The Dynagel Pond contained minimal vegetation (approximately 15 percent) and is adjacent to a manufacturing facility that operated until the 1980s (Photos 16-17). An above-ground storage tank and other manufacturing infrastructure are still in place, directly upgradient of the Dynagel Pond which leads to Wash 5. Throughout the Site area, which encompasses Media Component 3, there are remnants of the former railroad with tracks, switchboxes and electrical panels still intact.

Media Component 4 (White Waste and Drum Storage Area) encompasses a steep hillslope known as the White Waste Area (Photos 1-2). Gully erosion was evident on the hillslope of the White Waste Area supporting minimal (25 percent) vegetation cover. The Drum Storage Area is the 'valley' beneath the opposite side of the white waste hillslope (Photos 3-4). The Drum Storage Area was covered with sparse vegetation. No drums were evident; however, remnants of drums (lids, etc.) and ceramic packing materials were present in this location. These materials were previously characterized as non-hazardous in ESD #2. Off-site disposal of all these materials in the Drum Storage Area was reportedly completed during 2000.

Media Component 5 (Wash 3 Area excluding the OBOD Area) is a naturally-occurring drainage basin leading to the San Pedro River. Vegetated cover was minimal at the time of site inspection. Neither stockpiled soil nor drums were observed in this location, consistent with the 1999-2000 ESD #2 mandated removal.

Media Component 7 encompasses many drums and soil from 3 different locations (DNT waste outside Wash 3, near Wash 5/Warehouse 244). Adjacent to Pond 8, indirectly stabilizing the slope leading to Wash 5 from Pond 8, drums had been removed, in accordance with the prescribed Remedial Actions. Consistent with this action, drums evident in this area and severe bank erosion was apparent, similar to that of steep exposed hillslopes subject to high-intensity storms in this environment.

The TNT-contaminated Area, subject to a Removal Action, is located on a exposed hillslope between the Drum Storage Area and Pond 4B (Photos 5-6). There were obvious signs of soil removal from this area including: no vegetation cover, unnatural changes in the landscape due to excavated soil, and remaining removal tools and/or location markers. There were no signs of black staining on the soil surface. Downgradient of the TNT-contaminated area is a small drainage basin where runoff would appear to pond following a high-intensity storm. This area was also investigated during the Removal Action.

5.4.3 Wash 3 Leading to San Pedro River Surface Water

Wash 3 was dry at the time of the Site visit (Photos 11 and 25-27). This natural drainage path and planned wetlands discharge point widens and deepens as it nears the San Pedro River. Discharge piping to, and the outlet point from, the final planned discharge location at Wash 3 was observed to be in good condition but has never been in use. The San Pedro River was low at the time of the Site visit, occupying less than one-half of the observed basin (Photo 28). Moist soil adjacent to the river was covered in a white crystalline material at the surface in select locations. Green algae was present in small patches throughout the river. There was abundant domestic debris (water bottles, clothing, food cans) along Wash 3 and the San Pedro River indicative of trespassers of any age. The San Pedro River may be used as a drinking water supply by these trespassers, yet quantity and frequency are unknown and probably difficult if not impossible to estimate. There are no constructed barriers to this area. Due to the nature of the high-intensity, short-duration storms, fencing would be difficult to construct and maintain.

5.4.4 Inspection of Site Fencing and Signage

The perimeter fencing and signage surrounding ANP property appeared to be in good condition near the active operations area. Security was stringent near the main entrance to the operating facility which included a gate opened by security personnel only and a sign in/out book. Perimeter fencing encompassing inactive areas is adequately maintained. All media components are contained within the ANP boundaries, with the exception of impacted shallow aquifer groundwater in the northern area and the associated extraction system linked to SEW-1. Likewise, the impacted portion of the San Pedro River is not contained within ANP site boundaries. The access roads to the Site are generally well-maintained.

6.0 Technical Assessment

6.1 Functioning of the Remedy as Intended by Decision Documents

Remedial actions at Media Components 4, 5, 7, and 8 have been completed. The removal of hazardous materials from Media Components 4, 5, 7, and 8 has achieved remedial objectives of preventing human exposure and minimizing the migration of contaminants to groundwater and surface water.

Deep aquifer replacement wells were sampled and monitored for a period of 2 years following installation. Results of sampling last conducted in 1997, with the installation of the reverse osmosis tap units, indicate that the remedy is functioning as intended by the decision document. As stated previously, institutional controls are not in place beyond 1 mile of the ANP site in the location of formerly impacted drinking water supply wells. According to 2001 monitoring data, the nitrate-N plume in the shallow aquifer has decreased in size and is now contained within 1 mile of ANP property boundaries. Current institutional controls appear to be effective, because applicants with the intent to drill within this one-mile radius of the ANP Superfund Site are notified of Site conditions.

Sampling at Media Component 3 indicates that the decision to take no action at Media Component 3 is consistent with the ESDs for the Site and is protective of human health. However, a determination of the remedy's protectiveness with respect to environment has yet to be made. This determination will be made on the basis of the results of the ecological risk screening assessment currently in progress.

A remedy is not in place for the perched groundwater aquifer or the southern shallow aquifer due to the discovery of perchlorate contamination. Nitrate-N concentrations are generally increasing in perched zone piezometer P-03. The Apache Wash paleochannel provides a pathway for dewatering to the southern shallow groundwater aquifer once hydraulic head is sufficient. Discharge from the perched zone to the shallow zone slowed or ceased during 2001, evident from the changes in groundwater elevation. Currently MNA is under consideration as a remedy for these media components. The primary data gaps that would make effectiveness of MNA questionable are the hydraulic relationships between the MCA to the SPA and between the southern shallow aquifer and the San Pedro River. Hydrogeologic investigations are currently underway to obtain lithologic and groundwater data to fill these data gaps. Upon completion, MNA as a remedy will be further evaluated.

The NARS is expected to function effectively as intended by the decision document when full-scale startup begins. Effectiveness should be evaluated in terms of hydraulic containment of the nitrate-N plume in the shallow aquifer and mass removal by the NARS treatment system. Supply of a substantial carbon source, recirculation of treatment water, and intensive management of caterpillars are expected to result in increased denitrification capabilities and effluent less than MCL of 10 mg/L, as specified in the ROD. During delayed full-scale startup the nitrate-N plume has decreased in size and therefore, despite the delay in source control, the plume does not appear to have migrated in the shallow groundwater aquifer. Full-scale startup is intended to begin during 2003.

E. coli and fecal coliform may remain an impediment to discharge under National Pollutant Discharge Elimination System and bypass of the ANA is not anticipated to be an effective long-term solution given the expected increased denitrification capacity. Various technologies, such as a sand filter pack or a chlorination/dechlorination system, will be evaluated, if determined to be needed in the future.

6.2 Current Validity of Assumptions Used During Remedy Selection

The assumptions used to implement the remedy are generally unchanged, from the time of selection, for all areas contaminated with chemicals identified at the time of the ROD or the two ESDs. However, for perchlorate, a new groundwater COC that was just identified in 1998, a revised decision document will be necessary in the future for Media Components 1 and 2B. No standards have been changed that would effect the protectiveness of the remedy. No changes in exposure pathways have been identified.

6.3 Recent Information Affecting the Remedy

No new ecological risks or impacts from natural disasters have been identified. A new contaminant of concern, perchlorate, was discovered in the southern area groundwater system. The Site conceptual model was revised and a nitrate-N hot spot in the San Pedro River was rediscovered.

Perchlorate contamination greater than 4 µg/L appears to be limited to the southern area groundwater system. Concentrations in perched zone piezometer P-03 are at a maximum (810 µg/L) yet relatively stable. Perchlorate concentrations are increasing in monitoring well MW-15, indicating the plume is moving northward in the direction of groundwater flow. The revised site conceptual model does not effectively address the relationship between the Molinos Creek paleochannel and the San Pedro River. Hydrochemical data are very similar in the following locations: MW-14, MW-22, MW-01, SW-12, MW-06, MW-13 and D(18-21) 08bab, possibly indicating that the shallow groundwater aquifer adjacent to the San Pedro River is hydraulically connected with the surface flow in the San Pedro River (Figure 16). Evaluation of MNA is dependant upon confirmation of the lateral extent of the LCU identified as a low-permeability barrier within the southern shallow groundwater aquifer and identifying the relationship of the southern shallow aquifer to the San Pedro River. Subsurface investigations currently underway will provide more information regarding these relationships in order to accurately identify the effectiveness of future remedial actions.

During the preliminary investigation and remedial investigation, well point sampling and surface water sampling were performed at nine locations along the San Pedro River. A maximum of 47 mg/L nitrate-N for surface water and 1,100 mg/L for subflow were reported along a portion of the reach north of ANP property boundaries. Extensive surface water and well point sampling were carried out in October 2001 to determine if perchlorate was in the San Pedro River. At that time flow was low, and therefore, concentrations would not be diluted by the monsoon rains of the summer months. Perchlorate was not detected in any of the samples; however, extensive nitrate-N was. The southernmost detected sample was from a well point downgradient from the discharge point of Wash 5 with a concentration of 29 mg/L. A maximum of 400 mg/L nitrate-N was reported in a sample from a well point and surface water sample containing 52 mg/L, both downgradient of Wash 3 discharge point, known as the river hot-spot. Progressing down the river beyond the Pomerene Canal concentrations decreased to 24 mg/L. The downgradient extent of impact has not been defined.

Several theories were explored pertaining to the source of the river hot-spot. Due to the elevated concentrations and absence of perchlorate, the contaminant does not appear to be associated with the southern area shallow aquifer. It is thought that the hot-spot is the tail-end of a plume or commingled plumes emanating from Washes 4, 5, and 6. However, the monitoring well network downgradient of monitoring well MW-13 is insufficient to confirm this. Therefore remedial plans are dependent upon the following investigations, currently planned:

1. Construction of monitor wells MW-33 and MW-34 between well point WP-20180W (hot-spot) and MW-13.

2. Construction of monitor well MW-35 between surface water sampling point SW-11750 and the outcrop of St. David clay.

3. Investigation of San Pedro River in-stream flow rates.

The San Pedro River is not designated as a drinking water supply; however, it may be used by trespassers of all ages. In addition, the river is generally documented as a gaining and losing river throughout the basin, beyond the ANP boundaries. Therefore, there may be a minor risk, if the river discharges downstream to the shallow aquifer, as this is designated as a drinking water supply source.

An ecological risk screening assessment is currently underway. The results of this study may call into question the protectiveness of the remedies for Media Components 1, 2, and 3. The results of the ecological risk screening assessment will be discussed in an addendum to this report.

7.0 Conclusions and Recommendations

The following sections summarize conclusions and recommendations from the five-year review. Some recommended actions here include the anticipated schedule for completion of that action.

7.1 Issues Related to Groundwater and Surface Water

- The Carnes and Wooten shallow aquifer wells, previously used for monitoring and sampling points in the groundwater program, should either be repaired for continued use as monitoring wells or properly abandoned according to ADWR regulations depending on their usefulness as part of the monitoring network program.
- Replacement deep aquifer drinking water supply wells have not been sampled since 1996. These wells should be resampled to ensure that the remedy is remaining protective.
- Proceed with lithologic subsurface investigation of LCU to determine potential feasibility of MNA as a remedial action alternative.
- Proceed with additional hydrogeologic characterization near the San Pedro River hot-spot to identify the source of river contamination.
- Because EPA's Records Center and the Benson Library repository rely on paper documents for the administrative record, not electronic files, at a minimum, the Annual Groundwater Monitoring Report, should include historic data tables, including long-term data trends and data compilation, for data comparison.
- Concentrations of contaminants displayed on site wide figures included in the Comprehensive Groundwater Monitoring Reports should reflect all monitoring points sampled during that sampling period for comprehensive visual analyses.
- Hydrographs included in groundwater monitoring reports should be drawn to a scale that is appropriate for the data being represented, which is sometimes not the case, thus making data interpretation more difficult. Specifically, the concentration hydrographs for P-01, P-02, and MW-08.

7.2 Issues Relating to Soils

- Proceed with completion of the SLERA It is recommended that this report contain a comprehensive Site map(s) showing all impacted and formerly-impacted areas. The current Access database should be linked to available GIS-compatible mapping tools\software.

- Proceed with completion of the Ecological Risk Assessment with regards to areas governed under the state CD.
- Based on the results of the Ecological Risk Assessment it is recommended that evaluations and / or investigations proceed to determine remedial actions necessary for all ponds not yet addressed.
- Currently existing documentation relative to a comprehensive evaluation of areas under the jurisdiction of the EPA UAO versus the State's CD is minimal. EPA has required ANP conduct an ecological risk-screening of all known areas of soil contamination on the facility, regardless of agency jurisdiction and to prepare a comprehensive evaluation report. A continuation of this coordination is recommended.

7.3 Issues Relating to the NARS

- Efforts should be intensified to monitor wetland status and to try to achieve full-scale startup status during the summer of 2003. This will be enhanced by weekly reporting of wetland characteristics such as sampling results, total volume of influent and effluent, carbon additions, O & M activities conducted, and any other wetlands related activities.
- The O&M report should also evaluate: estimates of amount of contaminant removal, the hydraulic influence of pumping at SEW-1, water balance estimates, and analytical results for all discharge parameters (i.e., nitrate-N, coliform).
- Submit updated O&M Plan for EPA approval
- Evaluate and report on the effectiveness of control measures to prevent treatment cell bank erosion following the high intensity rainfall events.

8.0 Protectiveness Statements

The results of the five-year review indicate that the remedies for Media Components 4, 5, 7, 8, the vadose zone have remained protective of human health and the environment. Based on initial data over a two year period, deep aquifer replacement wells are functioning as intended and are remaining protective of human health within the study area boundary.

A protectiveness determination of the remedy cannot be made at this time for Media Components 1, 2, and 3. Further evaluation of the Site hydrogeology will be necessary to determine what actions, if any, will be required to protect groundwater.

A treatment wetlands was not constructed for the perched groundwater aquifer or the southern area shallow aquifer due to the discovery of perchlorate contamination and the potential ecological risks which could result from impounding perchlorate contaminated water. Currently MNA is under consideration as a remedy for these media components. The primary data gaps that would make effectiveness of MNA questionable are the hydraulic connectives of the MCA to the SPA, dependant upon the LCU, and the hydraulic relationship between the southern shallow aquifer and the San Pedro River. Further evaluation of the San Pedro River hotspot and the hydraulic relationship between the shallow groundwater aquifer and the river are necessary prior to any protectiveness determinations being made regarding this contaminated area.

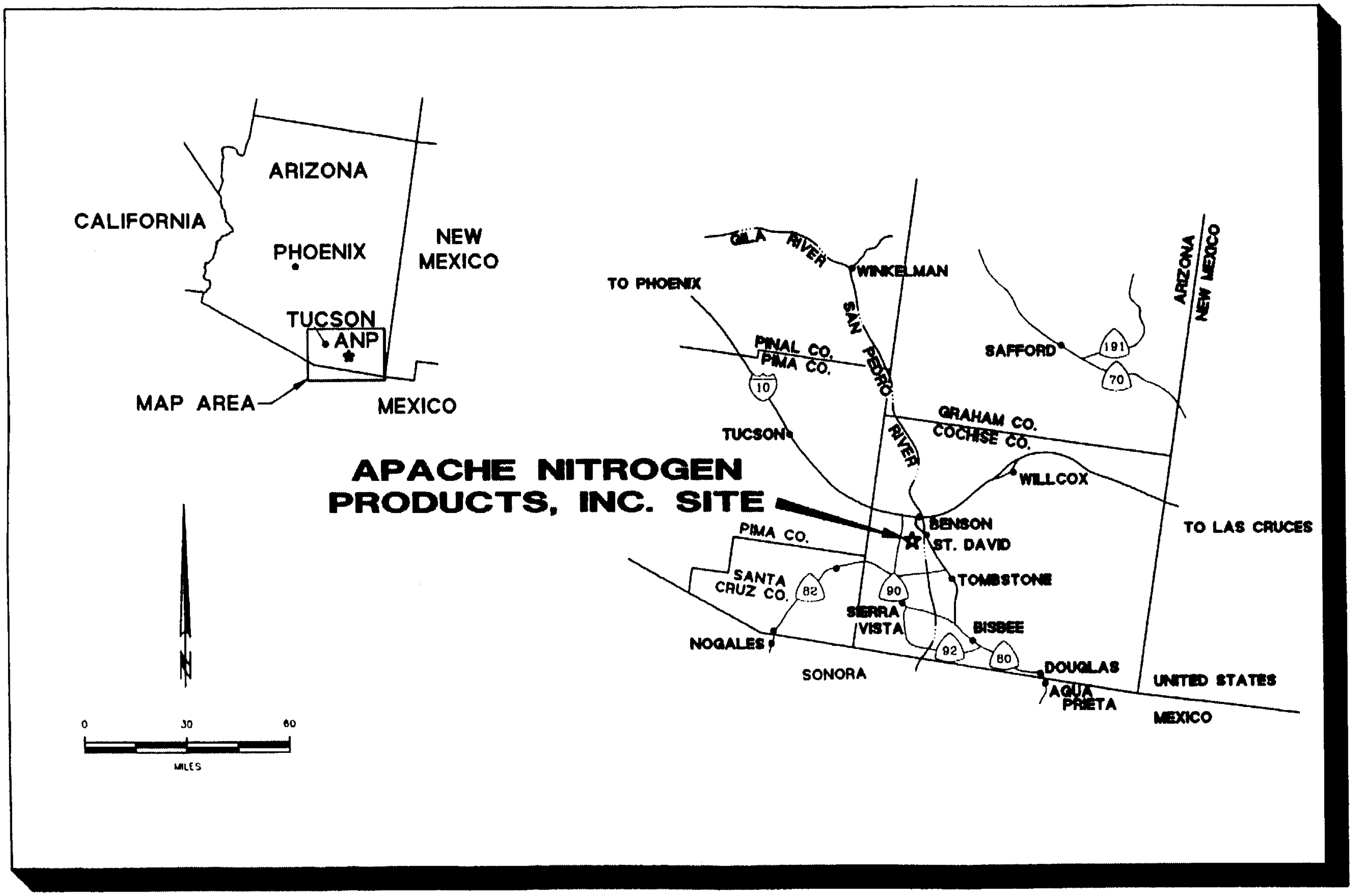
The NARS is expected to function effectively, as intended by the decision document, when full-scale startup begins. Effectiveness should and will be evaluated in terms of hydraulic containment of the nitrate-N plume in the shallow aquifer and mass removal by the NARS treatment system. During delayed full-scale startup, the nitrate-N plume has decreased in size and therefore, despite the delay in source control, the plume does not appear to have migrated in the shallow groundwater aquifer. Phosphorus and carbon deficiencies identified during startup testing in 2002 resulted in several operations and recycling adjustments being necessary. Full-scale startup of the NARS is now planned for 2003 and will be assisted by more intensive oversight and management of the NARS, including weekly reporting of all activities and results during the summer treatment season.

As a result of additional soil characterization and evaluation of the beneficial surface water management of the Inactive Ponds, the ROD-selected remedy of capping was not implemented. EPA is currently performing an ecological risk screening assessment to determine whether residual contaminant levels pose an unacceptable risk, whereby capping or another remedy would be required for Media Component 3.

The schedules for completion of remedial investigation pertaining to outstanding media components (1 through 3) have not been completely developed. Once each remedial alternative is operating according to the proposed action, they will be reviewed for the protectiveness. The additional investigation at Media Component 3 will determine whether a remedy is needed.

This Site requires ongoing five-year reviews to ensure that protectiveness is not compromised. The next review will be conducted during 2007.

FIGURES

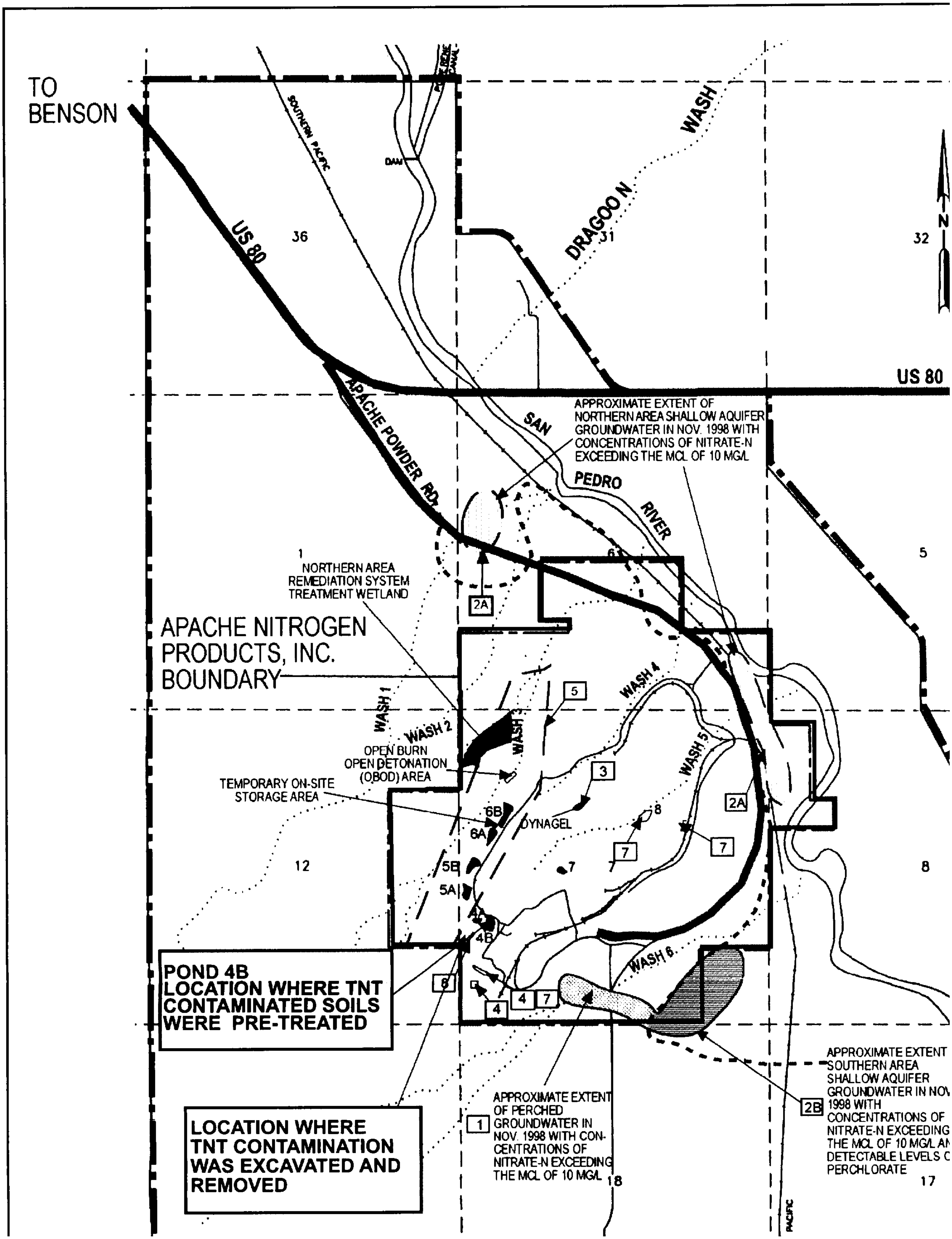


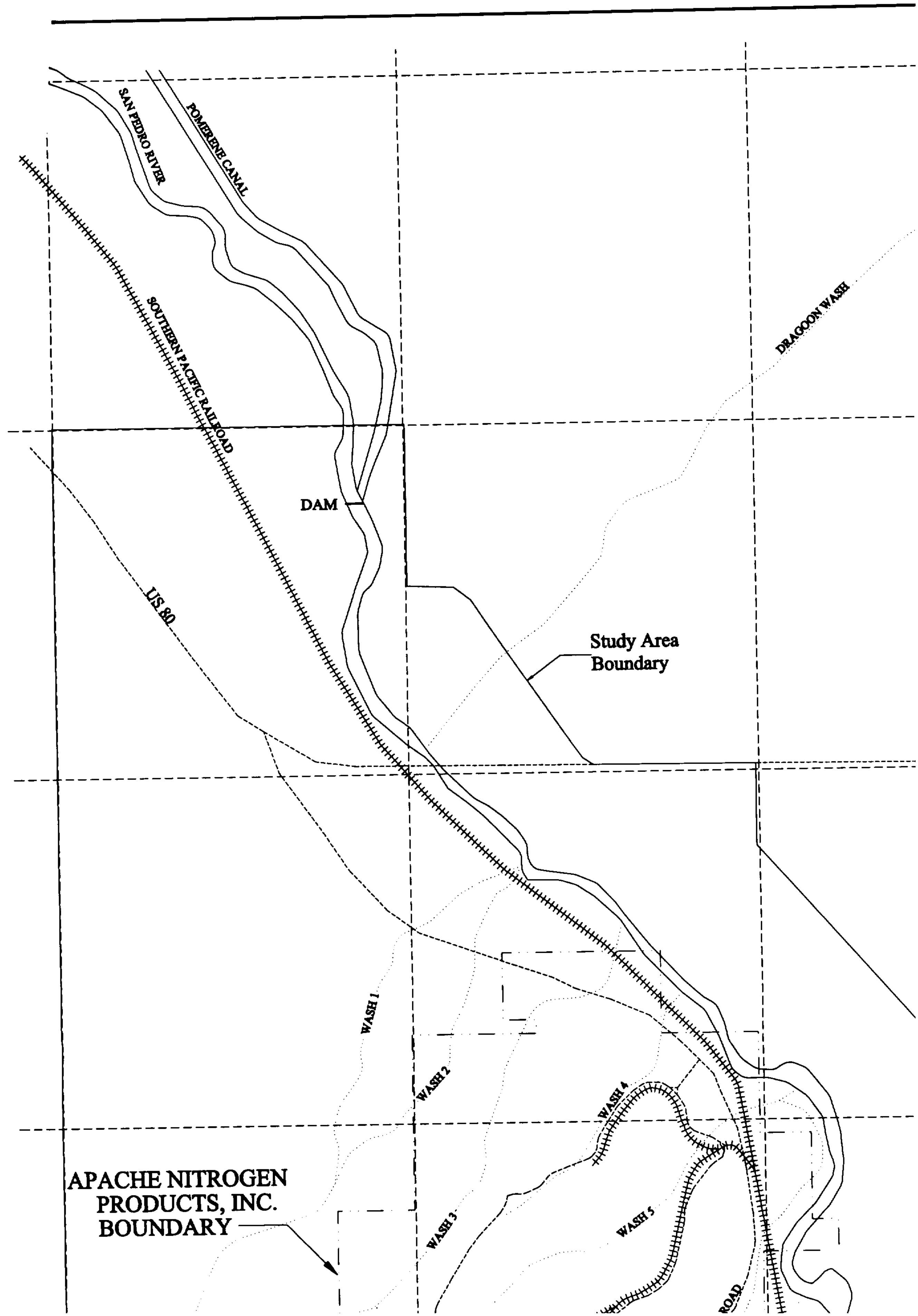
SOURCE: Hargis+Associates, Inc., 1998

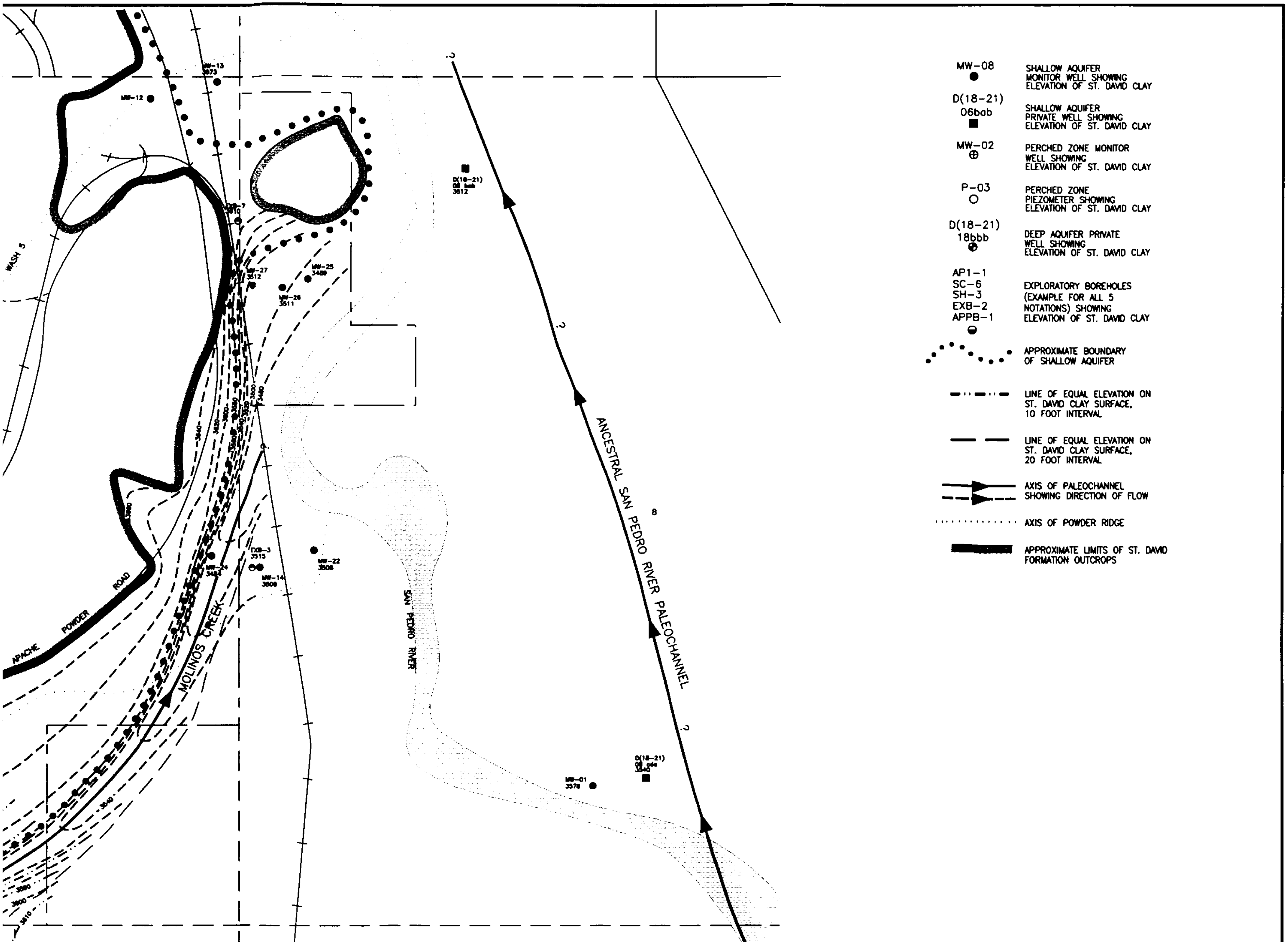
Figure 1

Location of Apache Nitrogen Products, Inc. Site

Cochise County, Arizona


TO
BENSON
US 80
36
DRAGOON WASH
31
32
N
SOUTHERN PACIFIC
DAM
US 80
APACHE POWDER RD.
SAN PEDRO RIVER
APPROXIMATE EXTENT OF NORTHERN AREA SHALLOW AQUIFER GROUNDWATER IN NOV. 1998 WITH CONCENTRATIONS OF NITRATE-N EXCEEDING THE MCL OF 10 MG/L
1
NORTHERN AREA REMEDIATION SYSTEM TREATMENT WETLAND
6
5
2A
APACHE NITROGEN PRODUCTS, INC. BOUNDARY
WASH 1
WASH 2
WASH 3
WASH 4
WASH 5
WASH 6
5
OPEN BURN OPEN DETONATION (OBOD) AREA
3
TEMPORARY ON-SITE STORAGE AREA
6B
6A
DYNAGEL
8
2A
7
7
7
7
12
5B
5A
4A
4B
8
POND 4B LOCATION WHERE TNT CONTAMINATED SOILS WERE PRE-TREATED
8
4
4
7
APPROXIMATE EXTENT SOUTHERN AREA SHALLOW AQUIFER GROUNDWATER IN NOV 1998 WITH CONCENTRATIONS OF NITRATE-N EXCEEDING THE MCL OF 10 MG/L AN DETECTABLE LEVELS O PERCHLORATE
2B
APPROXIMATE EXTENT OF PERCHED GROUNDWATER IN NOV. 1998 WITH CONCENTRATIONS OF NITRATE-N EXCEEDING THE MCL OF 10 MG/L
1
LOCATION WHERE TNT CONTAMINATION WAS EXCAVATED AND REMOVED
18
17
PACIFIC


SAN PEDRO RIVER
POMERENE CANAL
SOUTHERN PACIFIC RAILROAD
DRAGOON WASH
DAM
US 80
Study Area Boundary
WASH 1
WASH 2
WASH 3
WASH 4
WASH 5
ROAD
APACHE NITROGEN PRODUCTS, INC. BOUNDARY


MW-08
SHALLOW AQUIFER MONITOR WELL SHOWING ELEVATION OF ST. DAVID CLAY
D(18-21) 06bab
SHALLOW AQUIFER PRIVATE WELL SHOWING ELEVATION OF ST. DAVID CLAY
MW-02
PERCHED ZONE MONITOR WELL SHOWING ELEVATION OF ST. DAVID CLAY
P-03
PERCHED ZONE PIEZOMETER SHOWING ELEVATION OF ST. DAVID CLAY
D(18-21) 18bbb
DEEP AQUIFER PRIVATE WELL SHOWING ELEVATION OF ST. DAVID CLAY
AP1-1
SC-6
SH-3
EXB-2
APPB-1
EXPLORATORY BOREHOLES (EXAMPLE FOR ALL 5 NOTATIONS) SHOWING ELEVATION OF ST. DAVID CLAY
APPROXIMATE BOUNDARY OF SHALLOW AQUIFER
LINE OF EQUAL ELEVATION ON ST. DAVID CLAY SURFACE, 10 FOOT INTERVAL
LINE OF EQUAL ELEVATION ON ST. DAVID CLAY SURFACE, 20 FOOT INTERVAL
AXIS OF PALEOCHANNEL SHOWING DIRECTION OF FLOW
AXIS OF POWDER RIDGE
APPROXIMATE LIMITS OF ST. DAVID FORMATION OUTCROPS
ANCESTRAL SAN PEDRO RIVER PALEOCHANNEL
SAN PEDRO RIVER
MOLINOS CREEK
APACHE POWDER ROAD
WASH 5
MW-13
3673
MW-12
D(18-21)
3512
MW-25
3489
MW-26
3511
MW-27
3512
EXB-3
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MW-22
3508
MW-14
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MW-01
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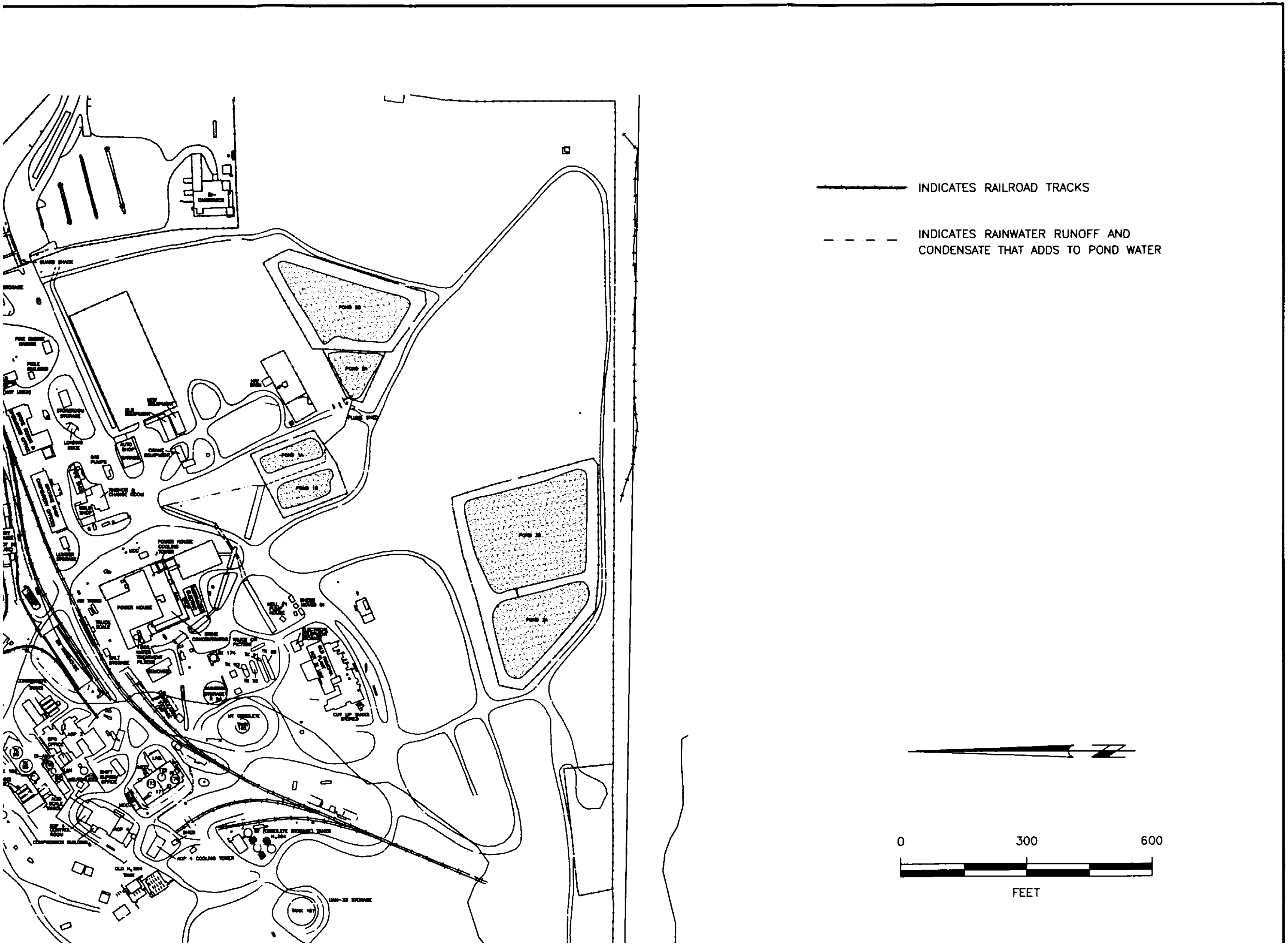
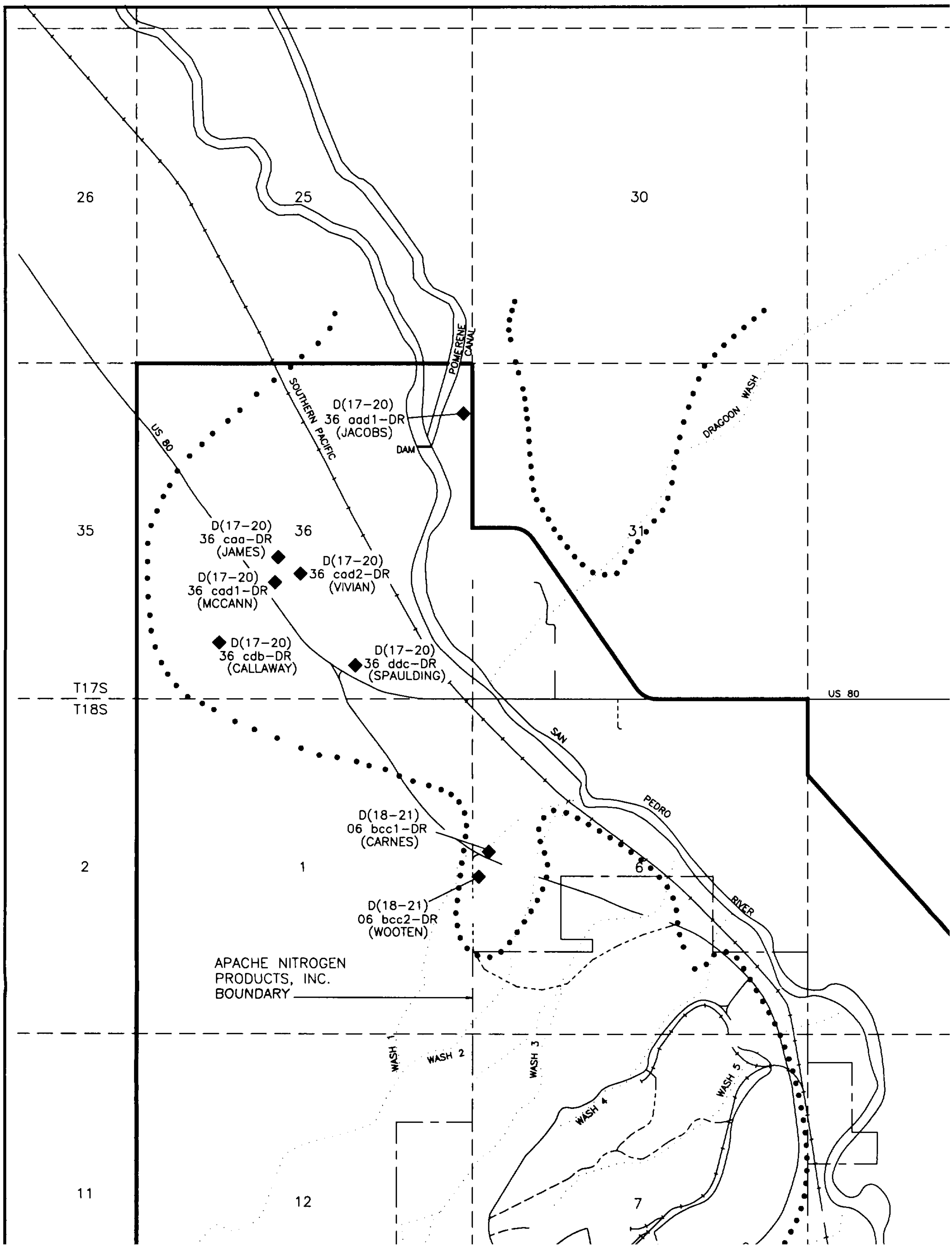
3600
3580
3480


INDICATES RAILROAD TRACKS
INDICATES RAINWATER RUNOFF AND
CONDENSATE THAT ADDS TO POND WATER
0
300
600
FEET
GUARD SHACK
POWER HOUSE
ADP 4 COOLING TOWER
COMPRESSOR BUILDING



26
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12
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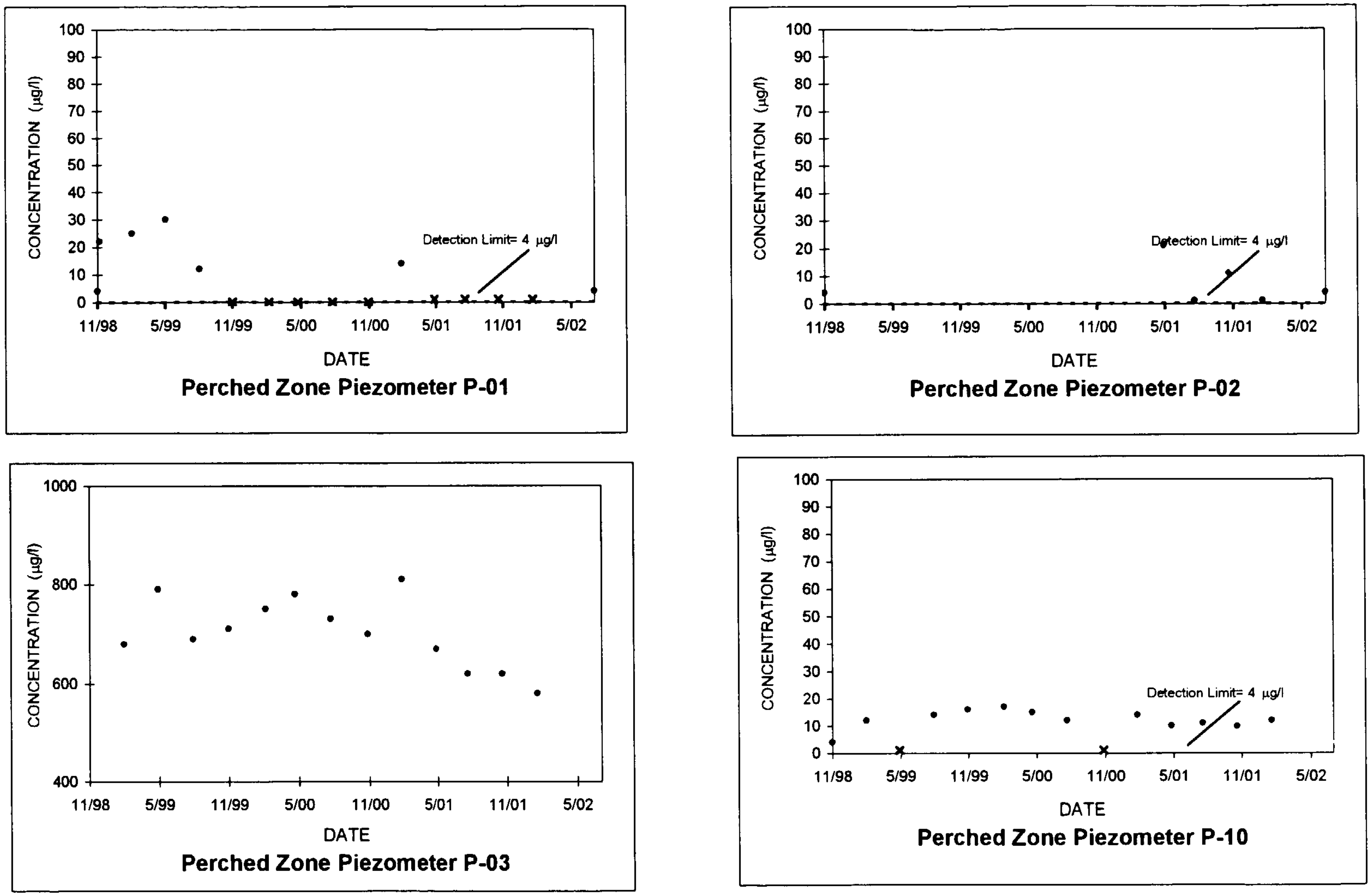
T17S
T18S
US 80
SOUTHERN PACIFIC
POMERENE CANAL
DAM
DRAGOON WASH
SAN PEDRO RIVER
D(17-20)
36 aad1-DR
(JACOBS)
D(17-20)
36 caa-DR
(JAMES)
D(17-20)
36 cad2-DR
(VIVIAN)
D(17-20)
36 cad1-DR
(MCCANN)
D(17-20)
36 cdb-DR
(CALLAWAY)
D(17-20)
36 ddc-DR
(SPAULDING)
D(18-21)
06 bcc1-DR
(CARNES)
D(18-21)
06 bcc2-DR
(WOOTEN)
APACHE NITROGEN
PRODUCTS, INC.
BOUNDARY
WASH 1
WASH 2
WASH 3
WASH 4
WASH 5

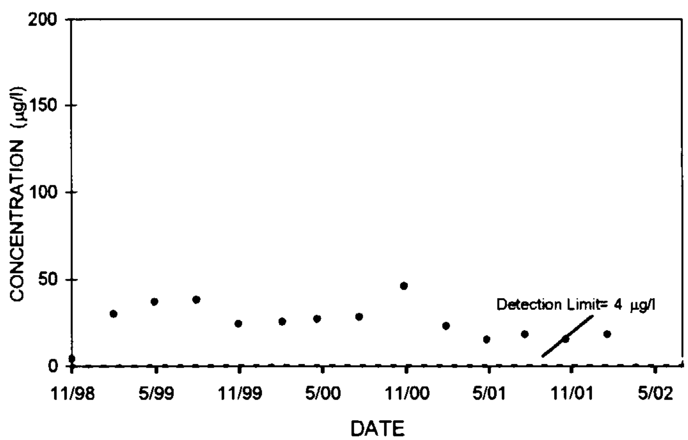


Note: see Figure 7b for explanation of abbreviations and symbols

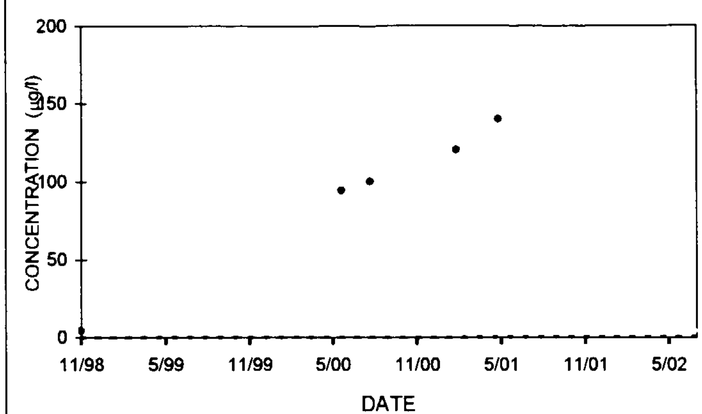
CH2MHILL

Source: Hargis & Associates, 2002

FIGURE 7a. WATER QUALITY HYDROGRAPHS FOR ClO_4 IN PERCHED ZONE PIEZOMETERS P-01, P-02, P-03, AND P-10



Perched Zone Monitor Well MW-03



Perched Zone Monitor Well MW-29

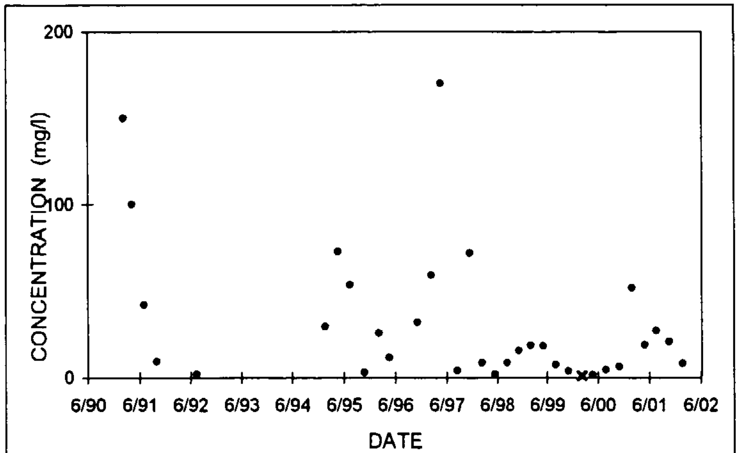
Notes:

MCL = Federal Maximum Contaminant Level
µg/l = Micrograms per liter
X = Not detected; Numerical value is less than the method detection limit
ClO_4 = Perchlorate
* = Value exceeds data range

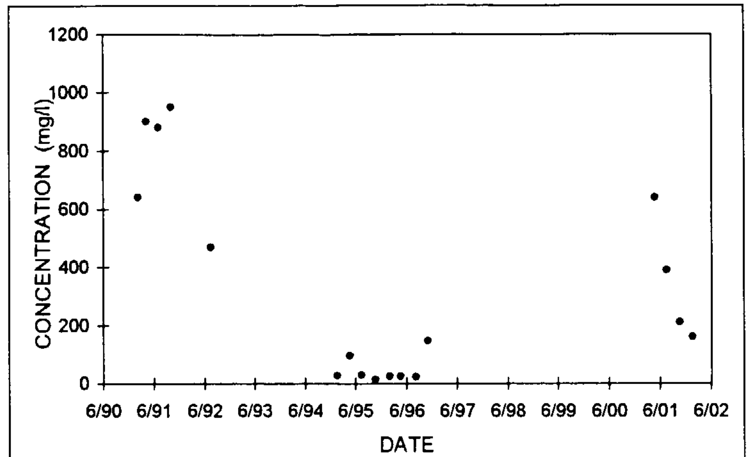
CH2MHILL

Source: Hargis & Associates, 2002

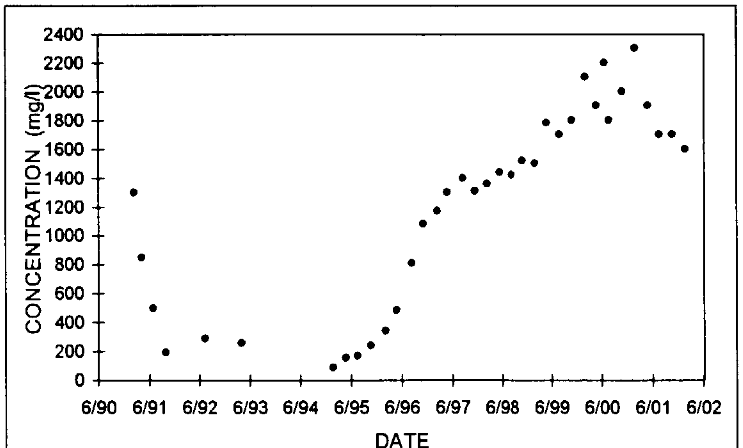
FIGURE 7b. WATER QUALITY HYDROGRAPHS FOR ClO_4 IN PERCHED ZONE MONITOR WELLS MW-03 AND MW-29



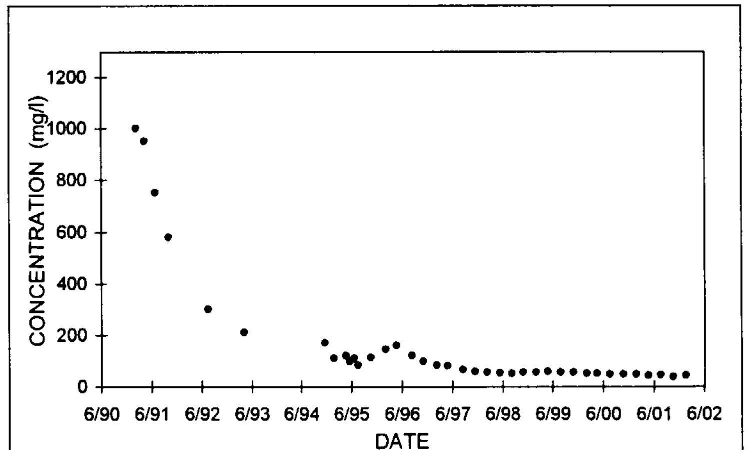
Perched Zone Piezometer P-01



Perched Zone Piezometer P-02



Perched Zone Piezometer P-03



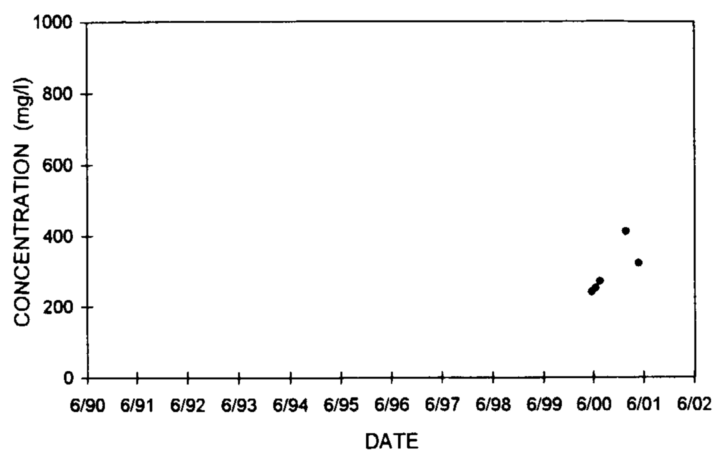
Perched Zone Piezometer P-10

Note: see Figure 7d for explanation of abbreviations and symbols

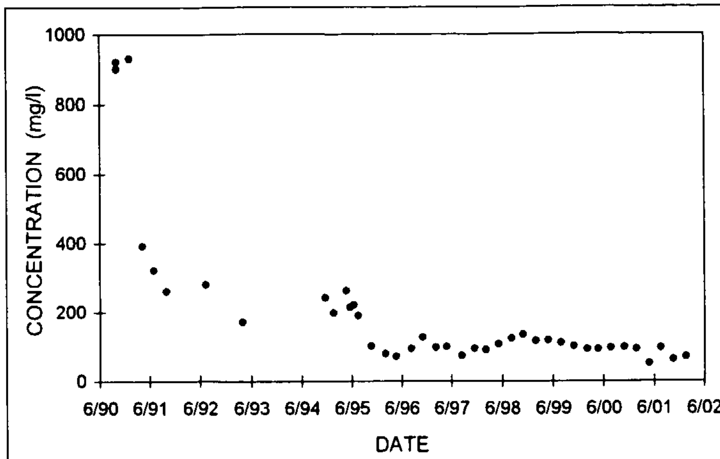
CH2MHILL

Source: Hargis & Associates, 2002

FIGURE 7c. WATER QUALITY HYDROGRAPHS FOR NO_3-N IN PERCHED ZONE PIEZOMETERS P-01. P-02. P-03 AND P-10



Perched Zone Monitor Well MW-29



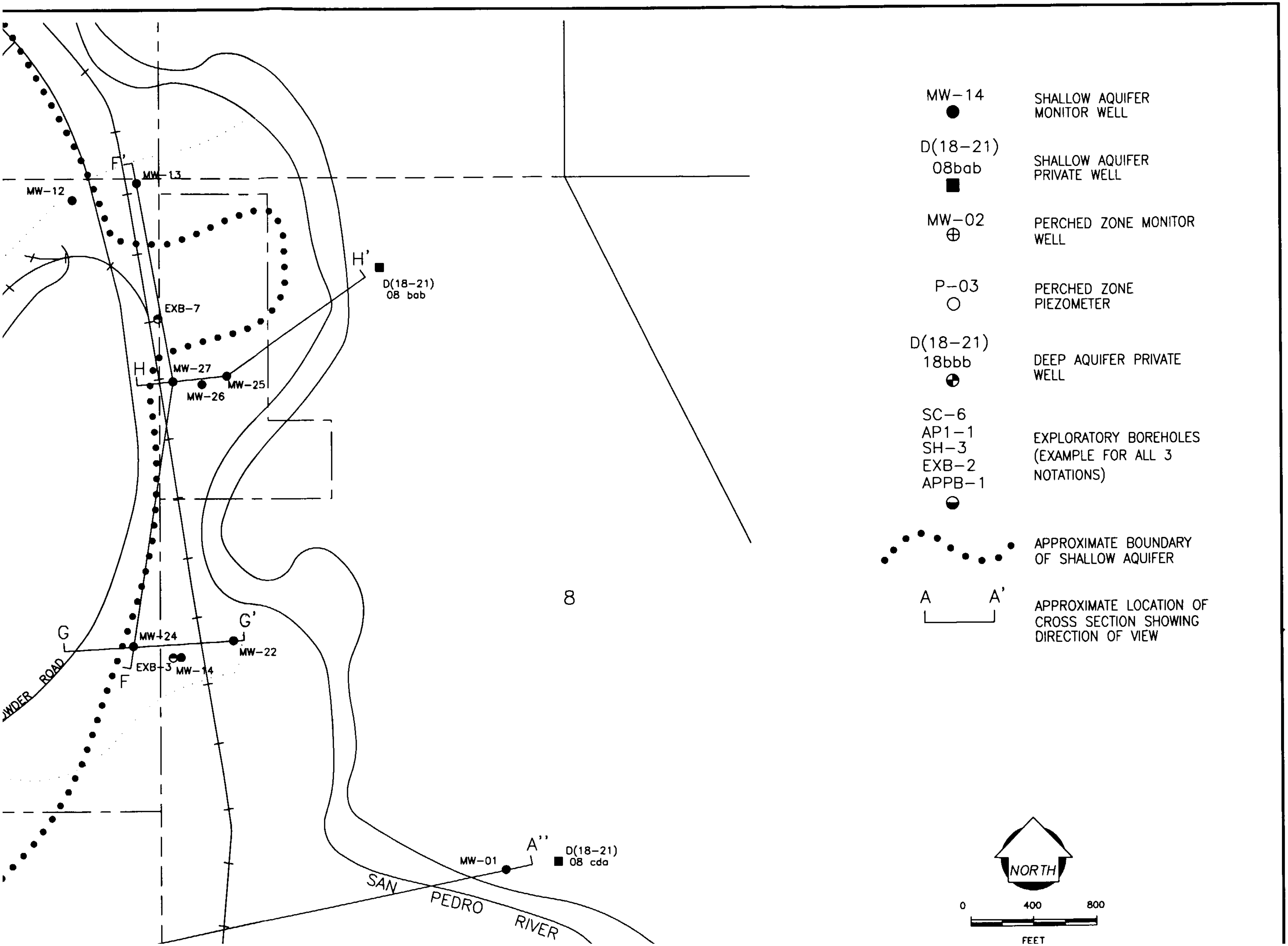
Perched Zone Monitor Well MW-03

Notes:

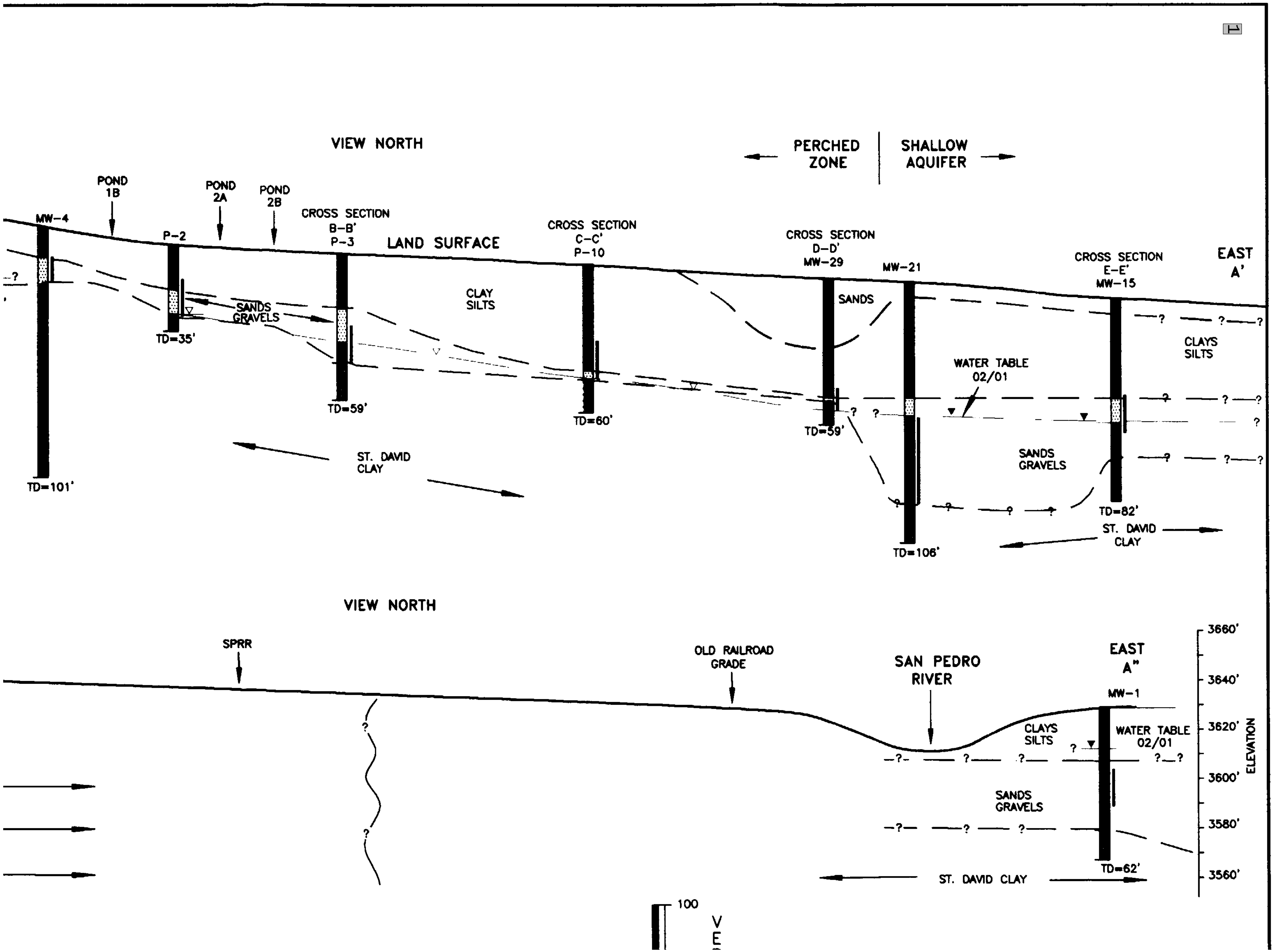
DRY = Water level is below bottom of screen; No formation water is present
ft msl = Feet above mean sea level
INS = Less than 1 foot of formation water is present; Insufficient to collect representative sample
MCL = Federal Maximum Contaminant Level
mg/l = Milligrams per liter
X = Not detected; Numerical value is less than the method detection limit
NO_3-N = Nitrate as nitrogen
* = Value exceeds data range

Source: Hargis & Associates, 2002

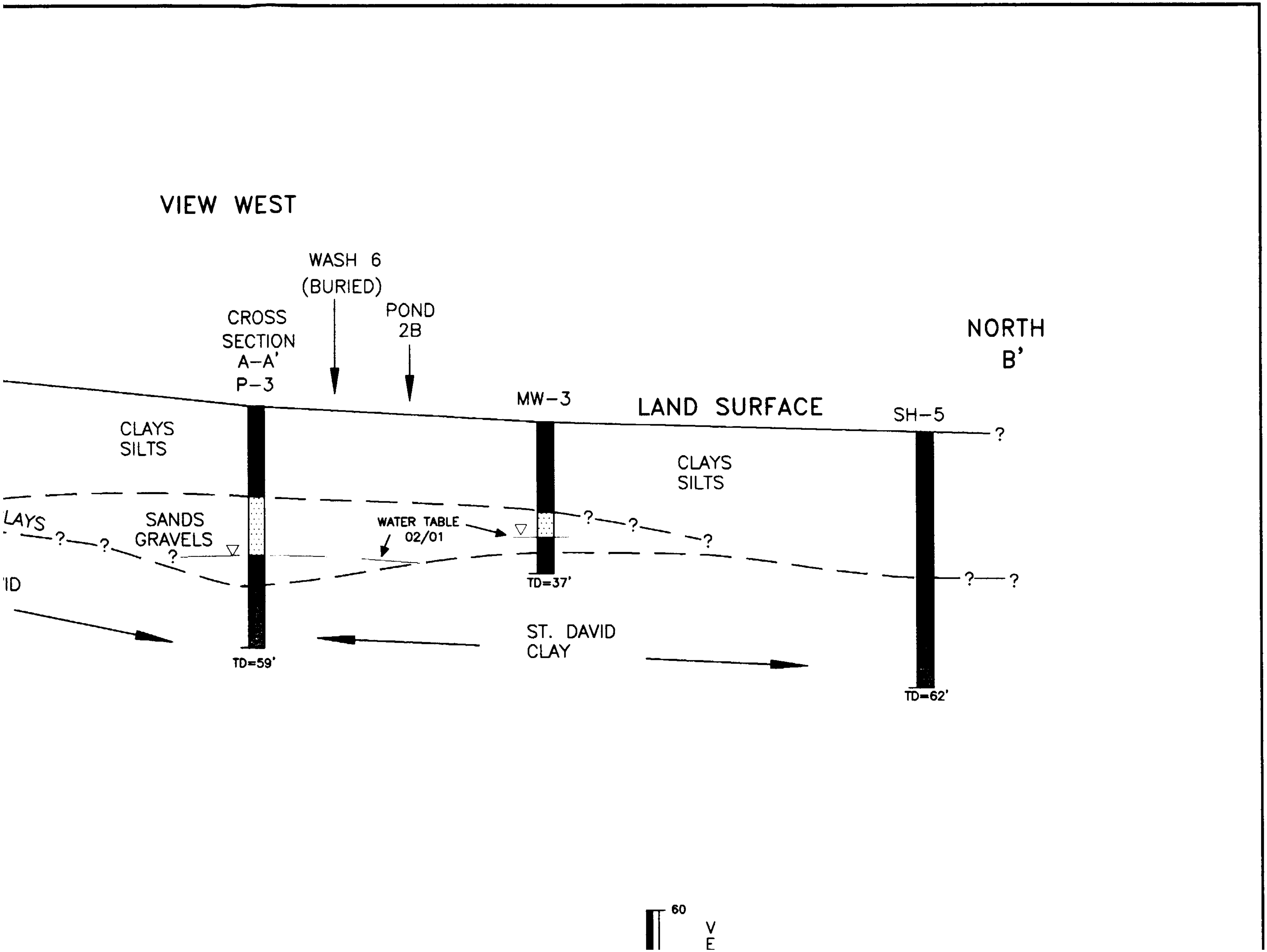
FIGURE 7d. WATER QUALITY HYDROGRAPHS FOR NO_3-N IN PERCHED ZONE MONITOR WELL MW-29 AND MW-03 AND SHALLOW AQUIFER MONITOR WELLS MW-01 AND MW-06



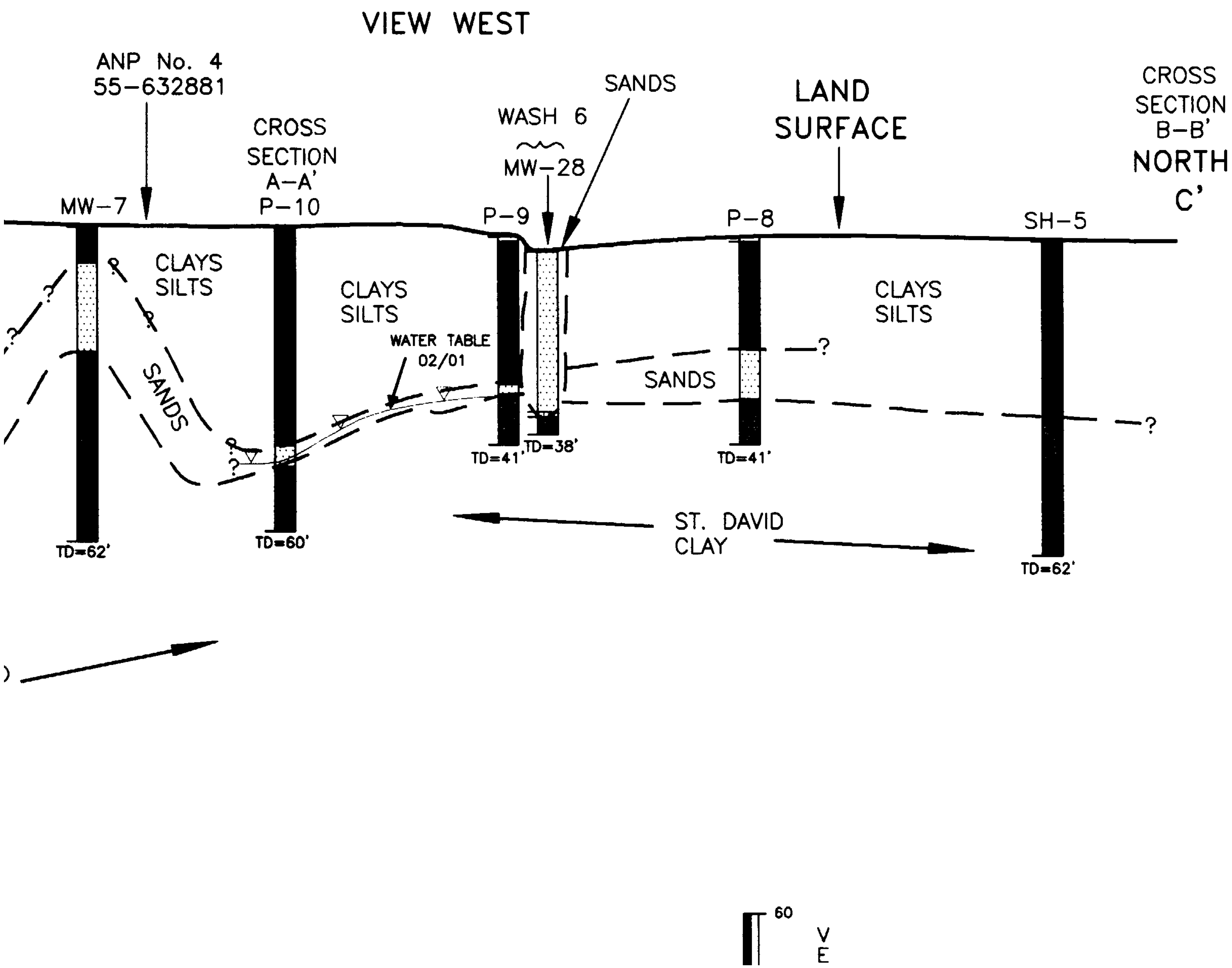
MW-12
F'
MW-13
EXB-7
H
MW-27
MW-26
MW-25
H'
D(18-21)
08 bab
8
G
MW-24
G'
MW-22
EXB-3
MW-14
F
ROAD
MW-01
A''
D(18-21)
08 cda
SAN PEDRO RIVER
MW-14
SHALLOW AQUIFER MONITOR WELL
D(18-21)
08bab
SHALLOW AQUIFER PRIVATE WELL
MW-02
PERCHED ZONE MONITOR WELL
P-03
PERCHED ZONE PIEZOMETER
D(18-21)
18bbb
DEEP AQUIFER PRIVATE WELL
SC-6
AP1-1
SH-3
EXB-2
APPB-1
EXPLORATORY BOREHOLES (EXAMPLE FOR ALL 3 NOTATIONS)
APPROXIMATE BOUNDARY OF SHALLOW AQUIFER
A
A'
APPROXIMATE LOCATION OF CROSS SECTION SHOWING DIRECTION OF VIEW
NORTH
0
400
800
FEET

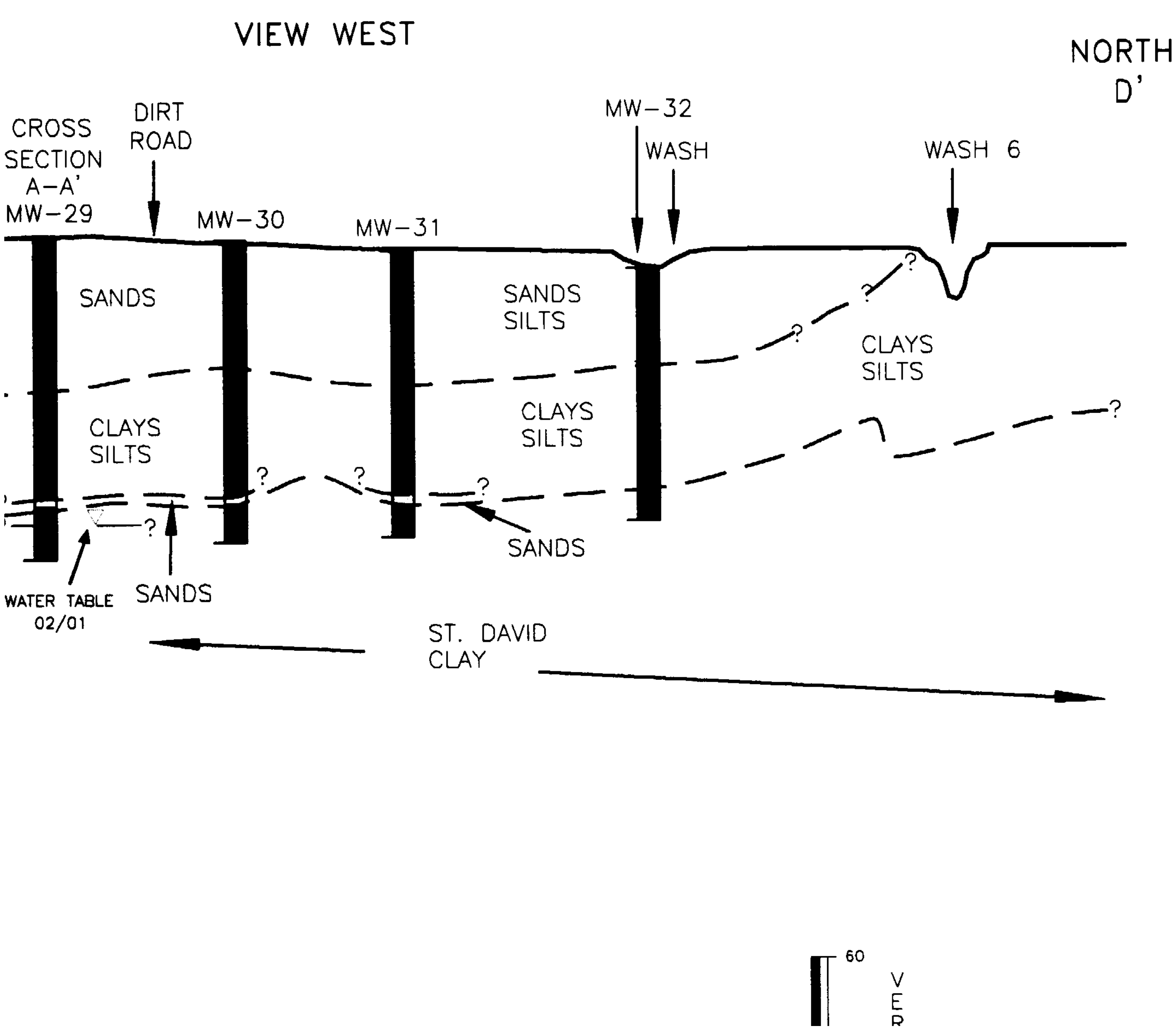


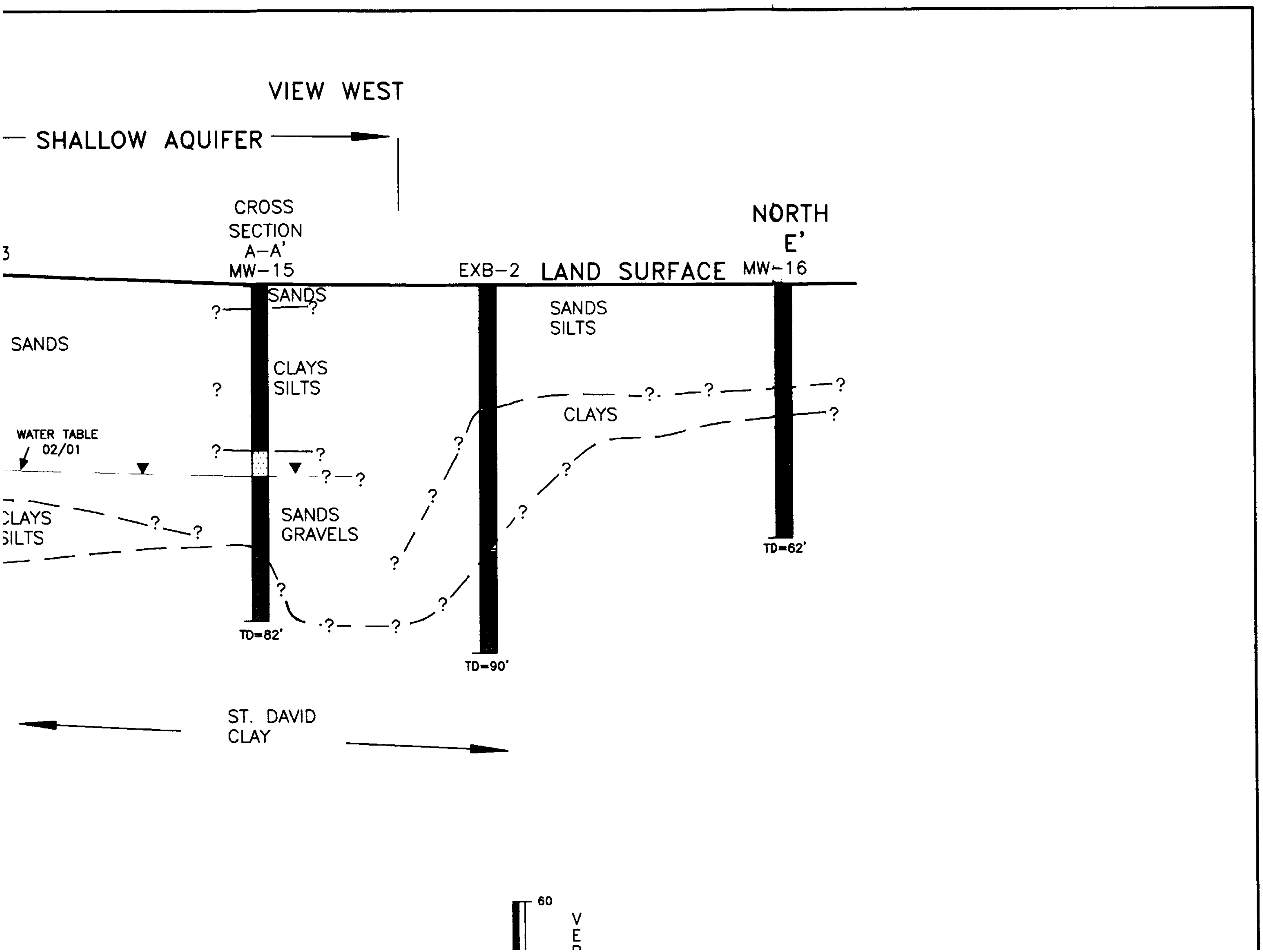
1
VIEW NORTH
PERCHED ZONE
SHALLOW AQUIFER
POND 1B
POND 2A
POND 2B
MW-4
P-2
CROSS SECTION B-B' P-3
LAND SURFACE
CROSS SECTION C-C' P-10
CROSS SECTION D-D' MW-29
MW-21
CROSS SECTION E-E' MW-15
EAST A'
SANDS GRAVELS
CLAY SILTS
SANDS
CLAYS SILTS
WATER TABLE 02/01
SANDS GRAVELS
TD=101'
TD=35'
TD=59'
TD=60'
TD=59'
TD=106'
TD=82'
ST. DAVID CLAY
ST. DAVID CLAY
VIEW NORTH
SPRR
OLD RAILROAD GRADE
SAN PEDRO RIVER
EAST A"
MW-1
CLAYS SILTS
WATER TABLE 02/01
SANDS GRAVELS
TD=62'
ST. DAVID CLAY
3660'
3640'
3620'
3600'
3580'
3560'
ELEVATION
100

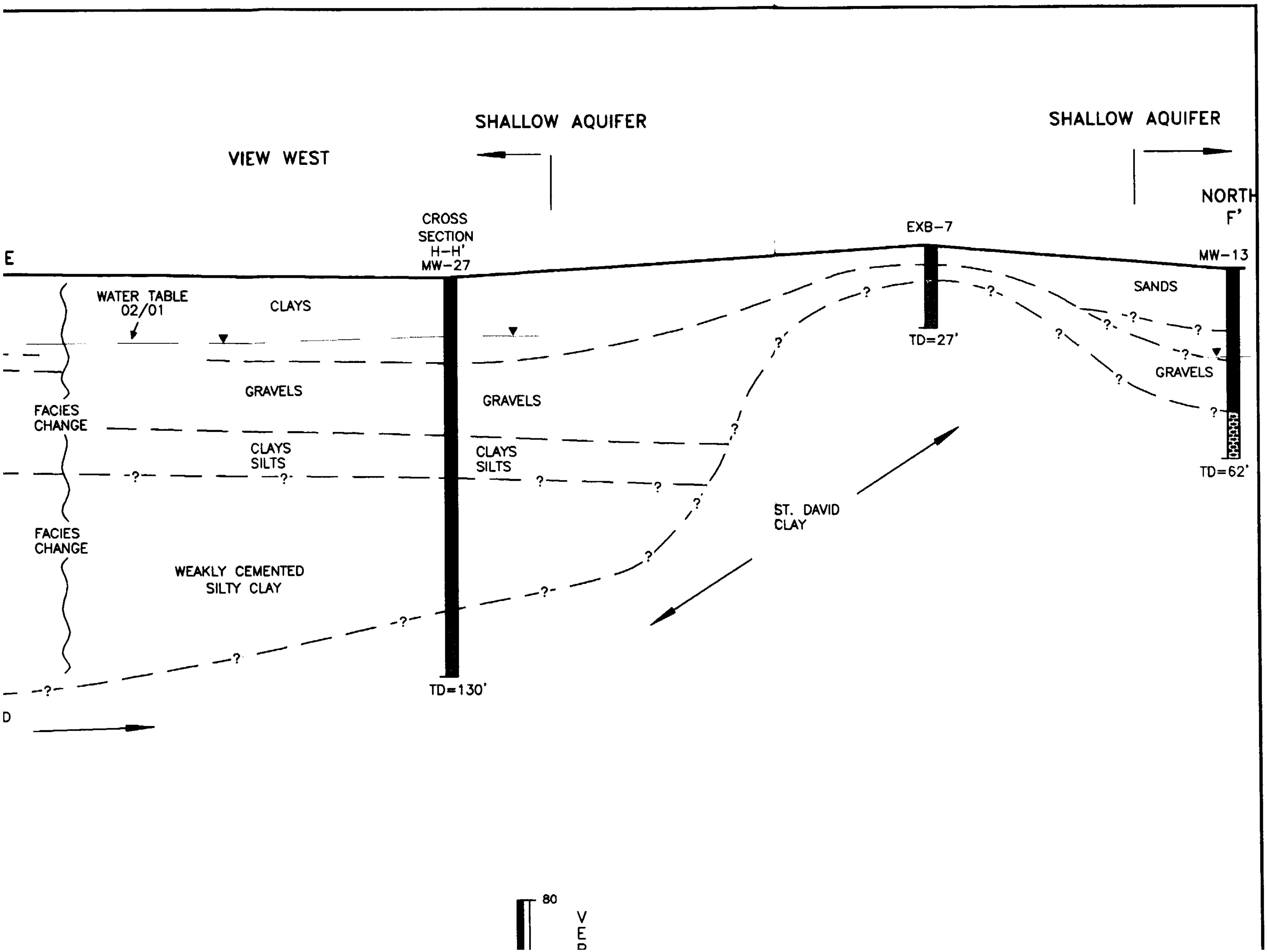


VIEW WEST
WASH 6
(BURIED)
CROSS
SECTION
A–A'
P–3
POND
2B
NORTH
B'
MW–3
LAND SURFACE
SH–5
CLAYS
SILTS
CLAYS
SILTS
SANDS
GRAVELS
WATER TABLE
02/01
TD=59'
TD=37'
TD=62'
ST. DAVID
CLAY
60
V
E

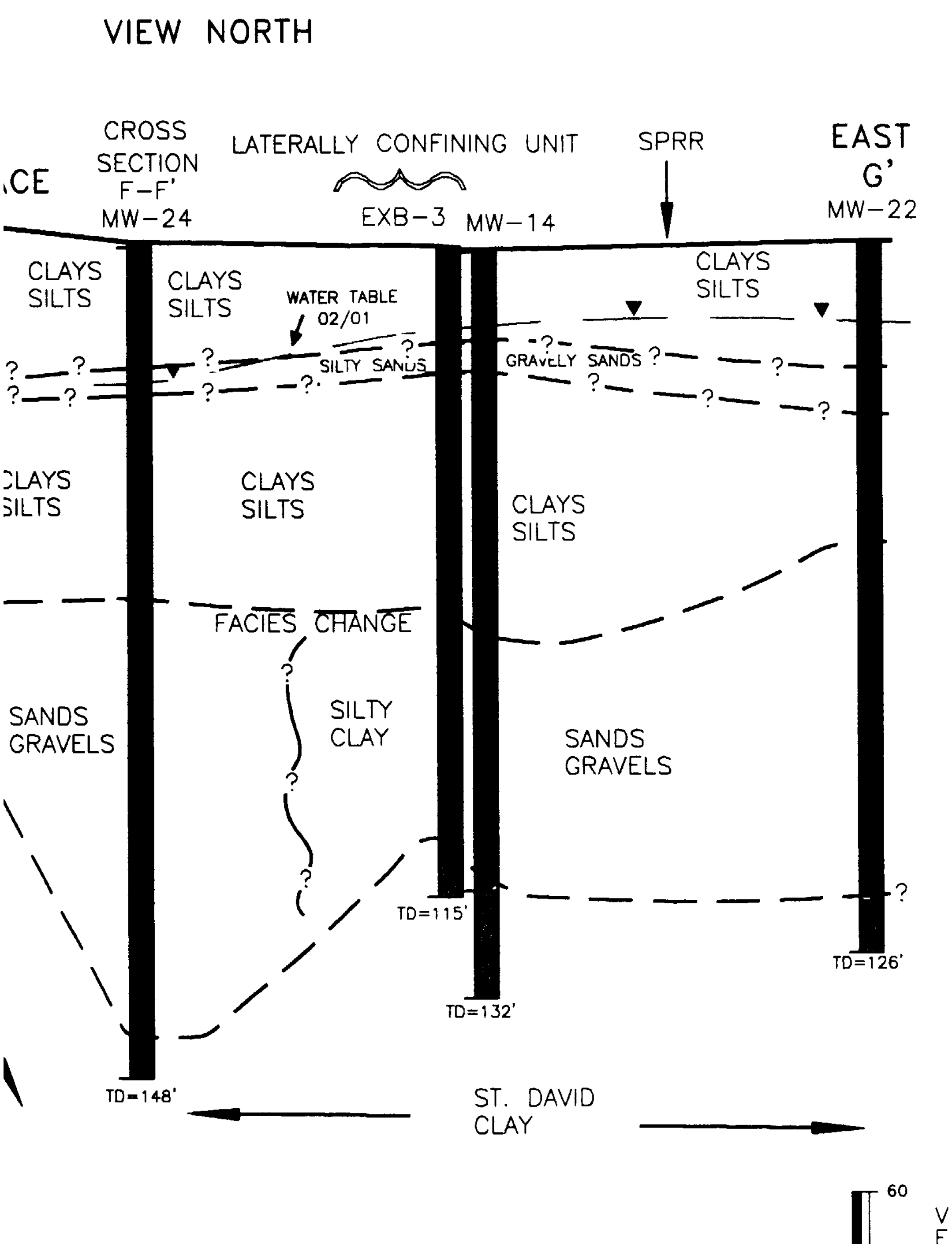

VIEW WEST
ANP No. 4
55-632881
MW-7
CROSS
SECTION
A-A'
P-10
CLAYS
SILTS
SANDS
CLAYS
SILTS
WATER TABLE
02/01
P-9
WASH 6
MW-28
SANDS
LAND
SURFACE
P-8
SANDS
CLAYS
SILTS
SH-5
CROSS
SECTION
B-B'
NORTH
C'
TD=62'
TD=60'
TD=41'
TD=38'
TD=41'
ST. DAVID
CLAY
TD=62'
60
V
E


VIEW WEST
NORTH
D'
CROSS SECTION A-A'
MW-29
DIRT ROAD
MW-30
MW-31
MW-32
WASH
WASH 6
SANDS
SANDS
SILTS
CLAYS
SILTS
CLAYS
SILTS
CLAYS
SILTS
SANDS
SANDS
WATER TABLE
02/01
ST. DAVID
CLAY
60
V
E

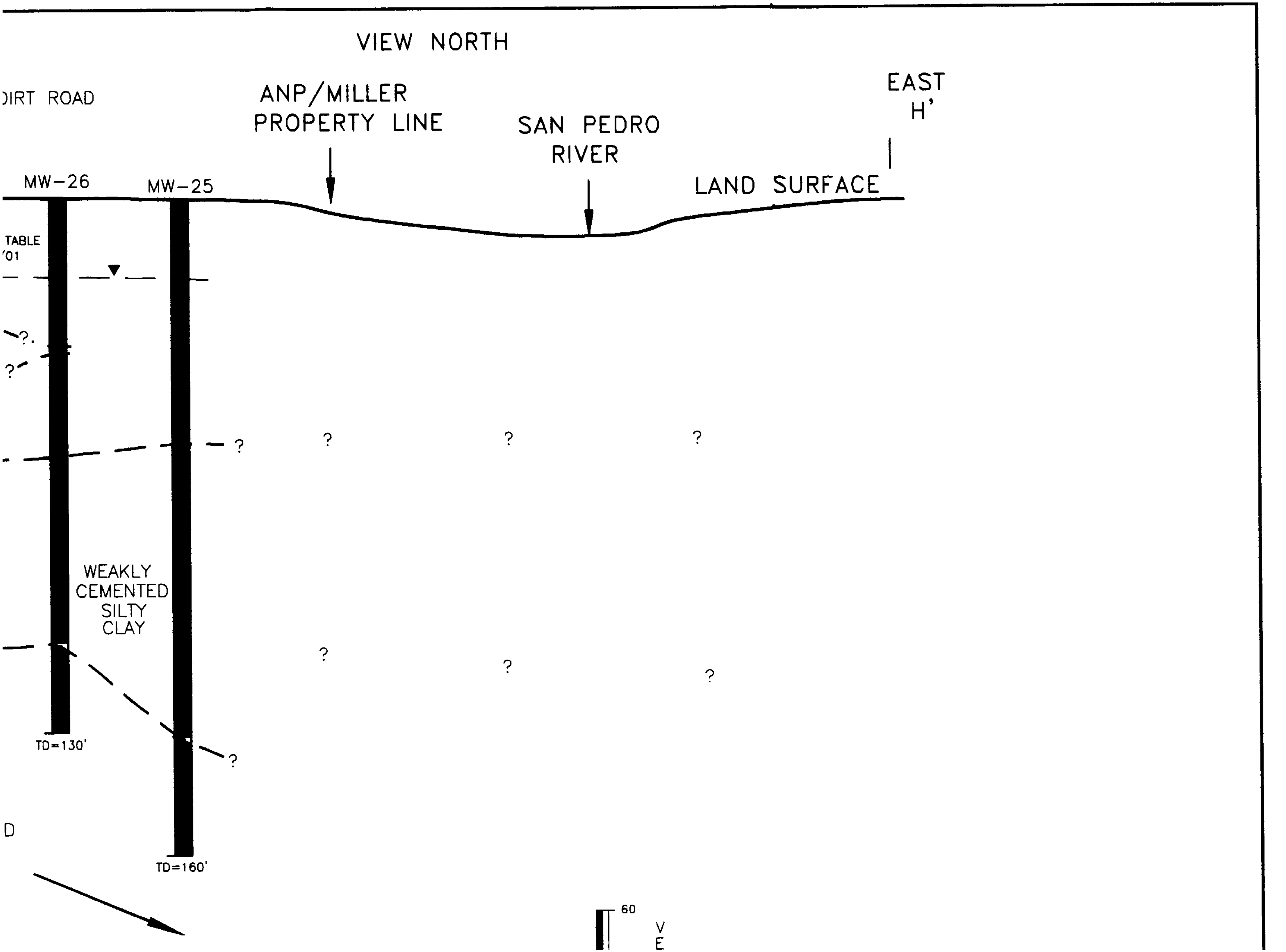

VIEW WEST
SHALLOW AQUIFER
CROSS SECTION A–A'
MW–15
EXB–2
LAND SURFACE
NORTH
E'
MW–16
SANDS
SANDS
CLAYS SILTS
SANDS SILTS
CLAYS
WATER TABLE 02/01
CLAYS SILTS
SANDS GRAVELS
TD=82'
TD=90'
TD=62'
ST. DAVID CLAY
60

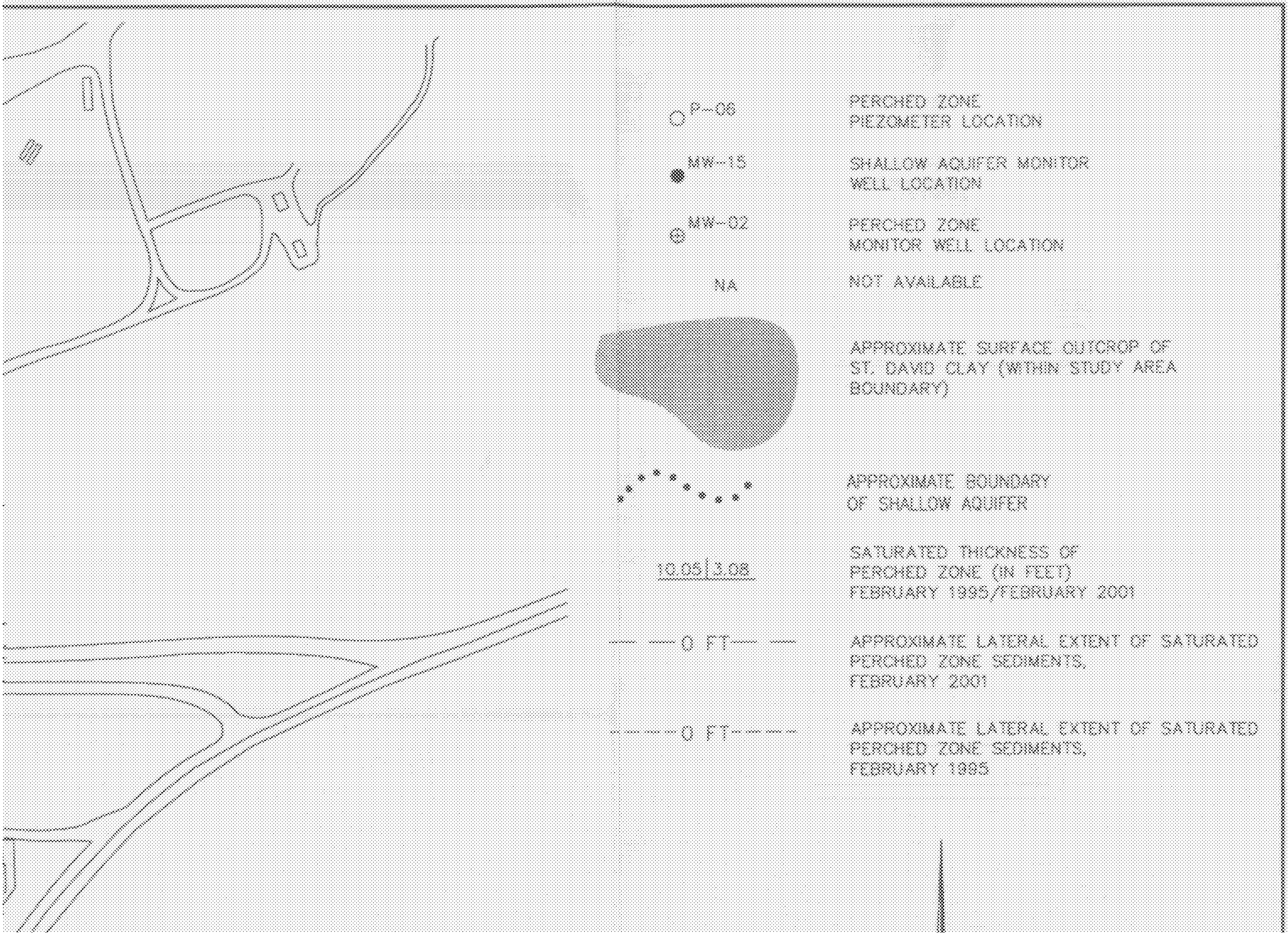


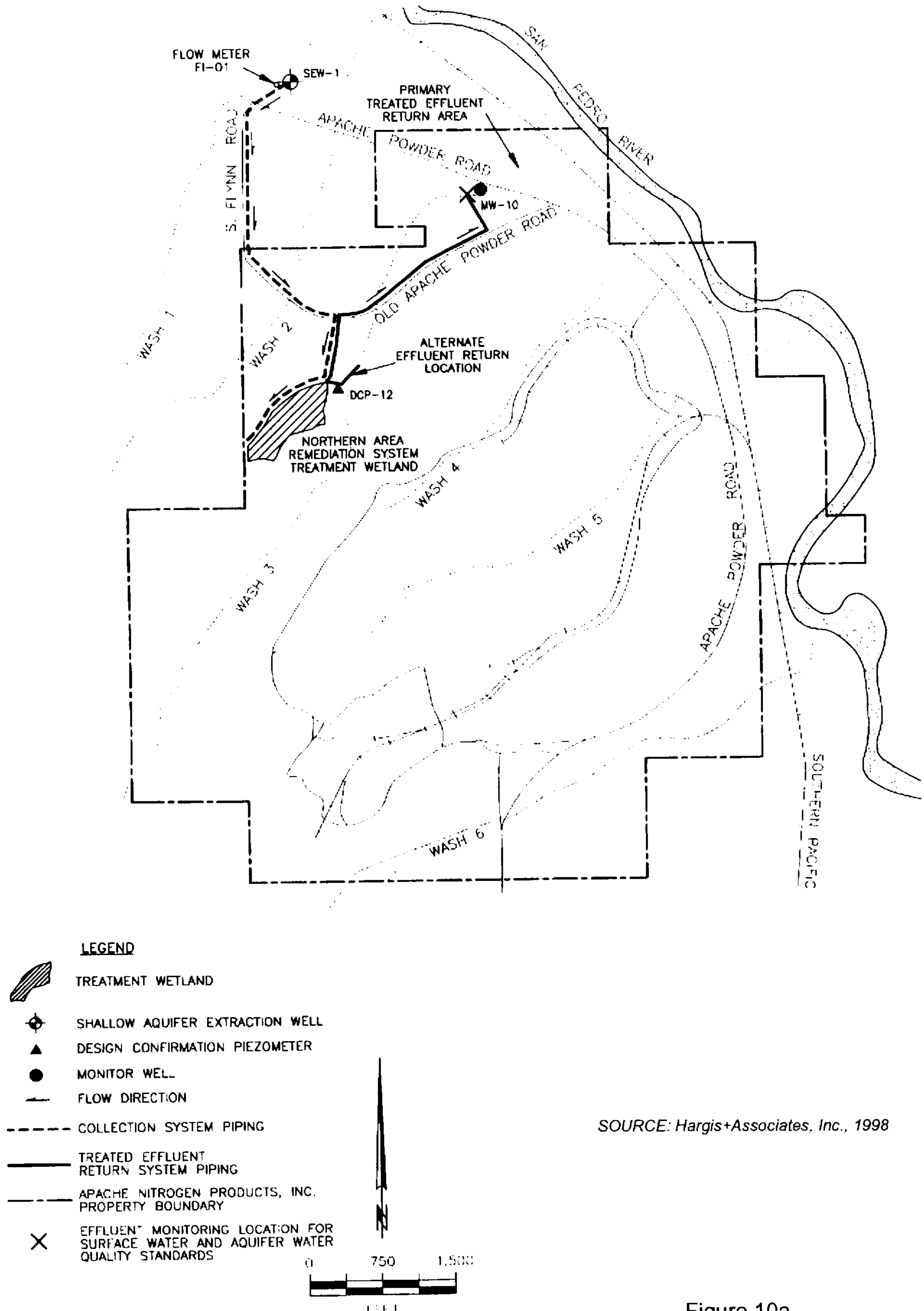
VIEW WEST
SHALLOW AQUIFER
SHALLOW AQUIFER
NORTH
F'
E
CROSS SECTION H-H' MW-27
EXB-7
MW-13
WATER TABLE 02/01
CLAYS
GRAVELS
GRAVELS
CLAYS SILTS
CLAYS SILTS
FACIES CHANGE
FACIES CHANGE
WEAKLY CEMENTED SILTY CLAY
ST. DAVID CLAY
SANDS
GRAVELS
TD=27'
TD=62'
TD=130'
D
80
VE



VIEW NORTH
CROSS SECTION F–F'
MW–24
LATERALLY CONFINING UNIT
EXB–3
MW–14
SPRR
EAST G'
MW–22
ACE
CLAYS SILTS
CLAYS SILTS
CLAYS SILTS
WATER TABLE 02/01
SILTY SANDS
GRAVELLY SANDS
CLAYS SILTS
CLAYS SILTS
CLAYS SILTS
FACIES CHANGE
SILTY CLAY
SANDS GRAVELS
SANDS GRAVELS
TD=115'
TD=132'
TD=126'
TD=148'
ST. DAVID CLAY
60
V
F

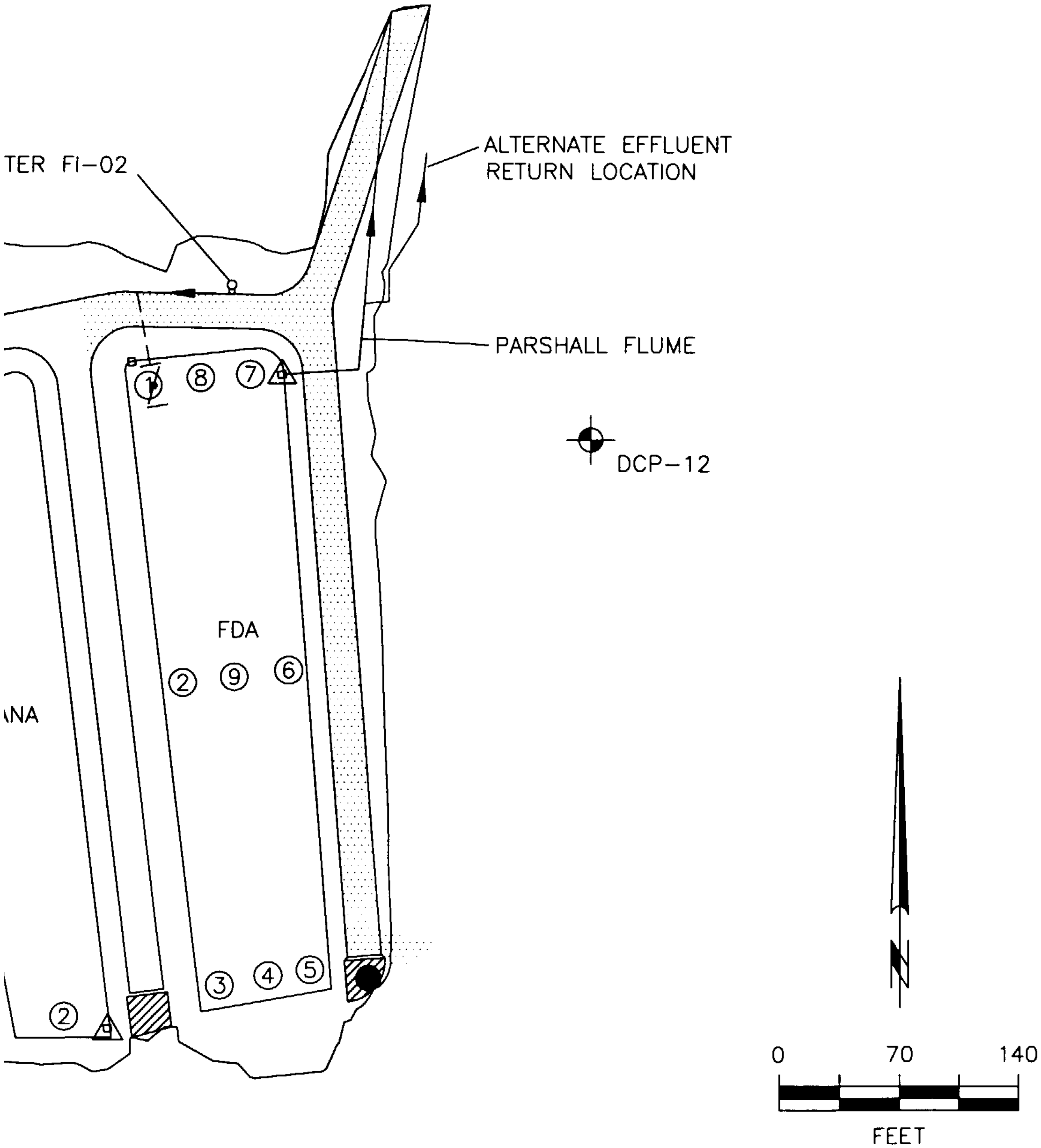

VIEW NORTH
DIRT ROAD
ANP/MILLER PROPERTY LINE
SAN PEDRO RIVER
EAST
H'
LAND SURFACE
MW-26
MW-25
TABLE
'01
?
WEAKLY CEMENTED SILTY CLAY
TD=130'
TD=160'
D
60
V
E


P-06
PERCHED ZONE PIEZOMETER LOCATION
MW-15
SHALLOW AQUIFER MONITOR WELL LOCATION
MW-02
PERCHED ZONE MONITOR WELL LOCATION
NA
NOT AVAILABLE
APPROXIMATE SURFACE OUTCROP OF ST. DAVID CLAY (WITHIN STUDY AREA BOUNDARY)
APPROXIMATE BOUNDARY OF SHALLOW AQUIFER
10.05|3.08
SATURATED THICKNESS OF PERCHED ZONE (IN FEET) FEBRUARY 1995/FEBRUARY 2001
0 FT
APPROXIMATE LATERAL EXTENT OF SATURATED PERCHED ZONE SEDIMENTS, FEBRUARY 2001
0 FT
APPROXIMATE LATERAL EXTENT OF SATURATED PERCHED ZONE SEDIMENTS, FEBRUARY 1995



SOURCE: Hargis+Associates, Inc., 1998

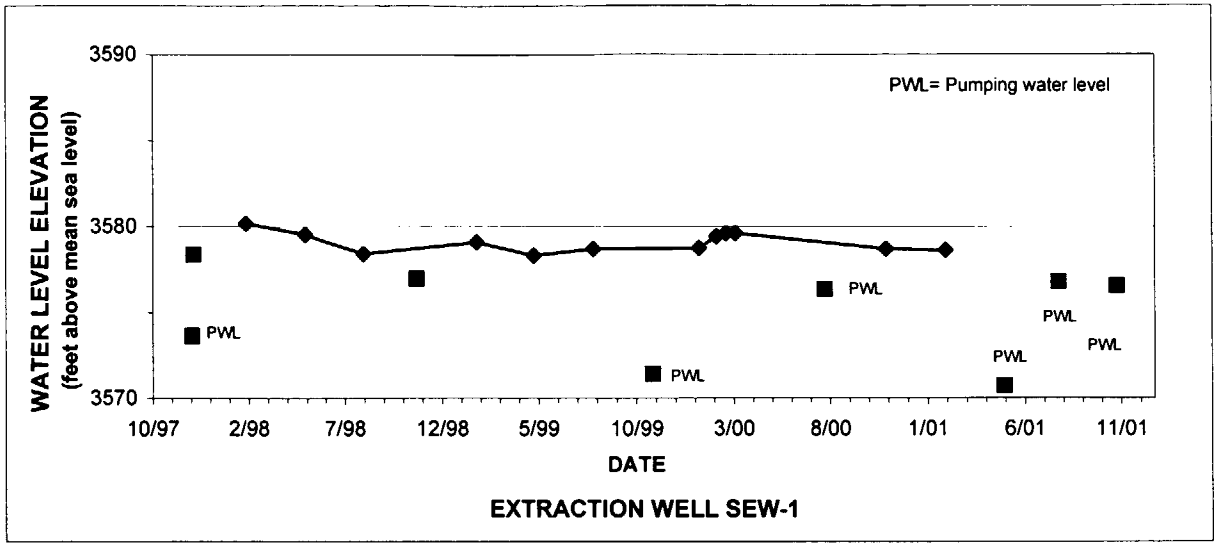
Figure 10a
Northern Area Remediation System Plot Plan

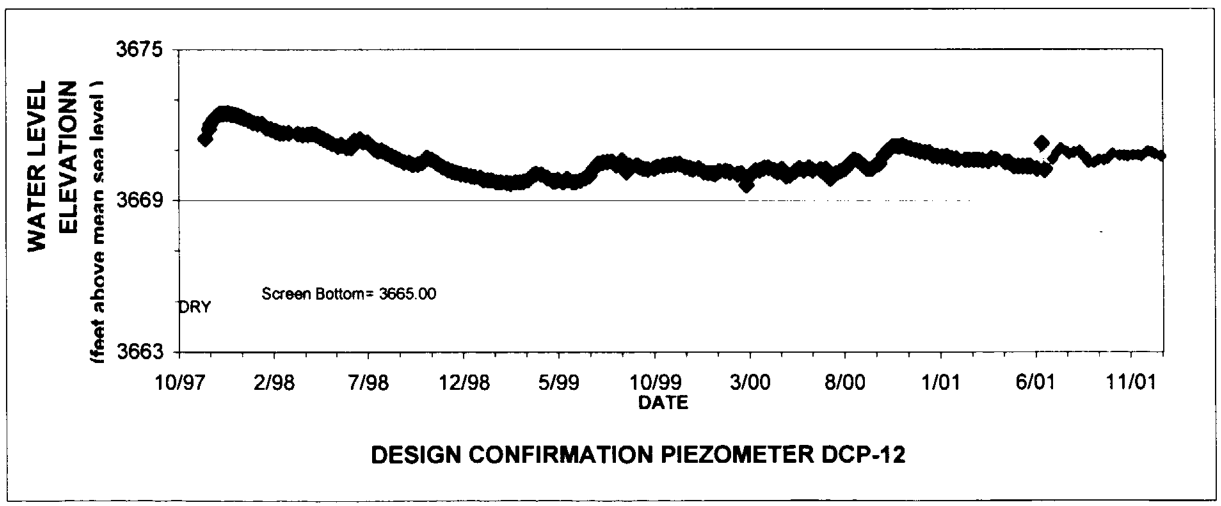


EXPLANATION

DCP-12 DESIGN CONFIRMATION PIEZOMETER

⑤ DISSOLVED OXYGEN (DO) MONITORING LOCATION

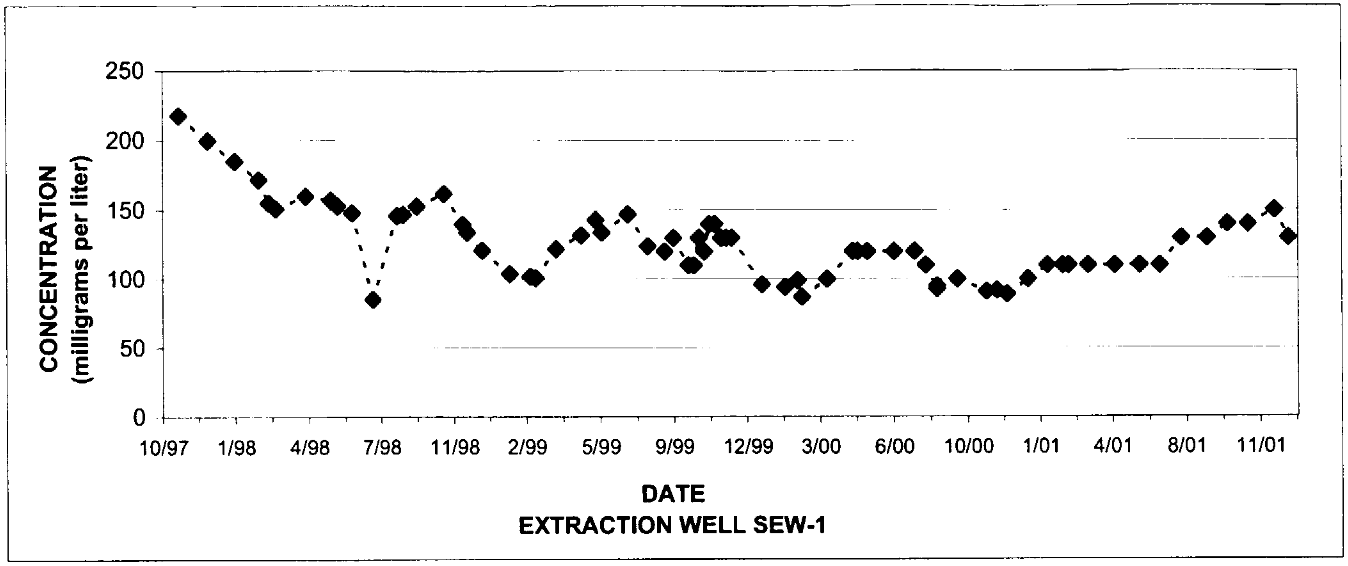




CH2MHILL

Source: Hargiss & Associates, 2001

FIGURE 11. WATER LEVEL HYDROGRAPHS FOR EXTRACTION WELL SEW-1 AND DESIGN CONFIRMARION PIEZOMETER DCP-12



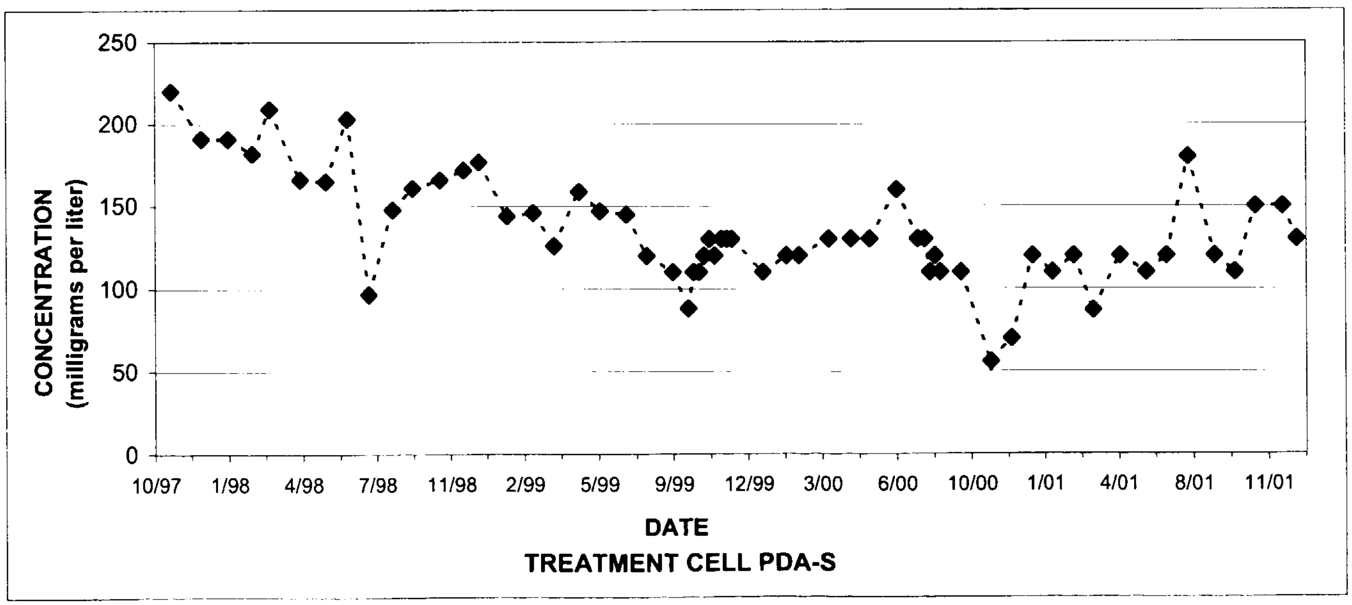
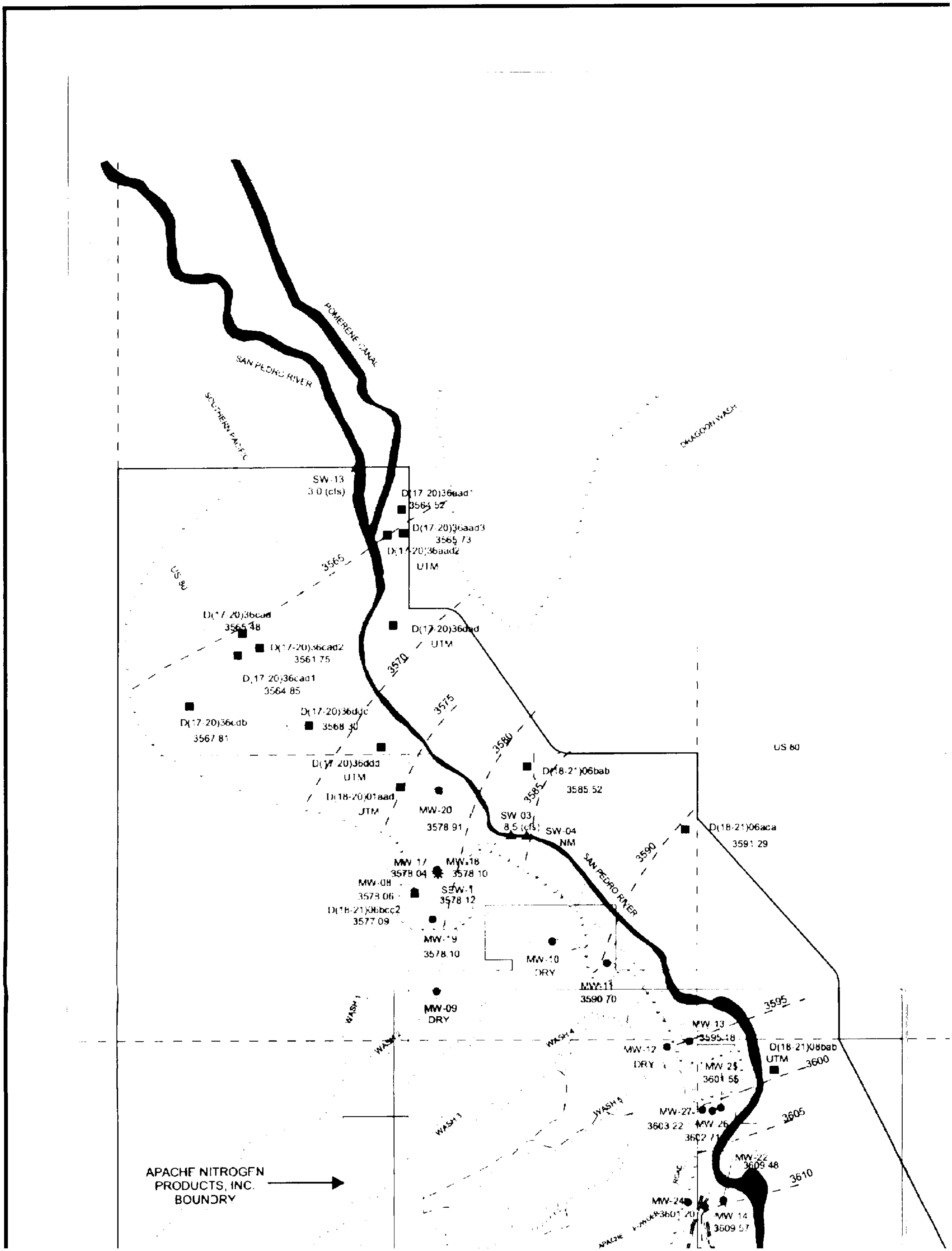
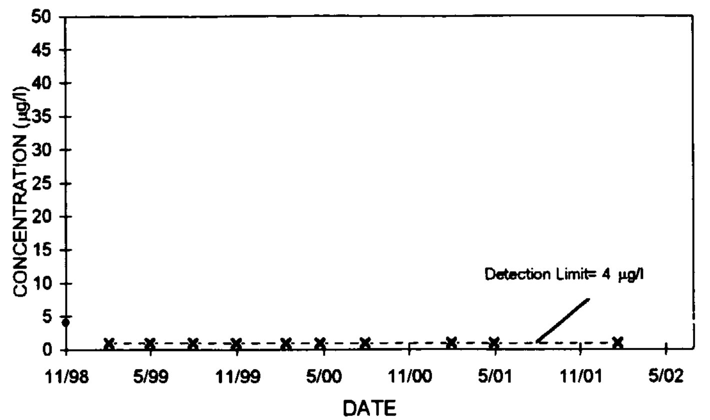


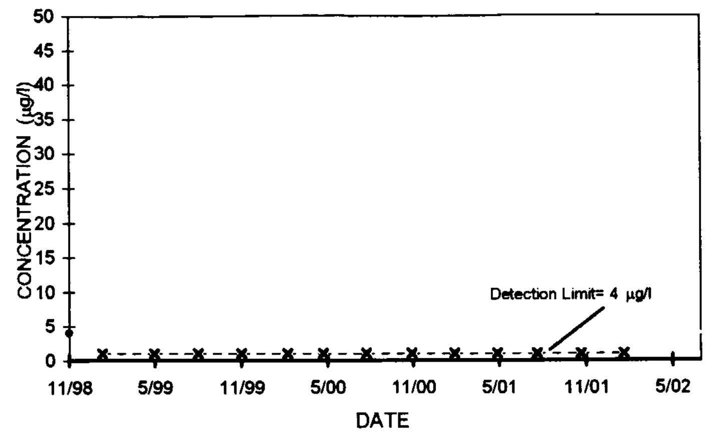
Figure 12
Water Quality Hydrograph for NO_3-N in NARS Extraction Well SEW-1 and Treatment Cell PDA-S



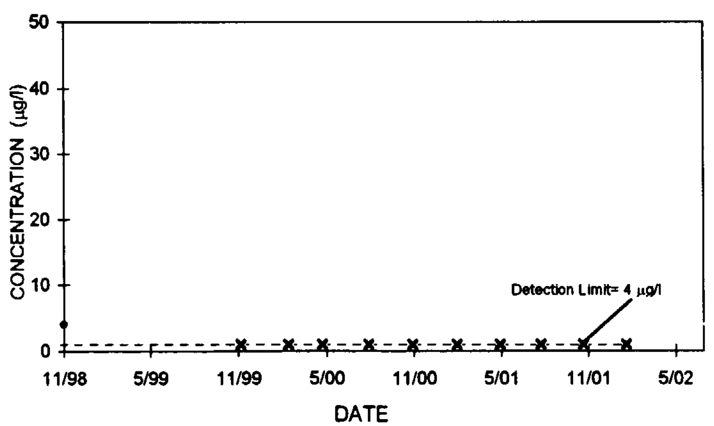
POMERENE CANAL
SAN PEDRO RIVER
SOUTHERN PACIFIC
DRAGOON WASH
SW-13
3.0 (cfs)
D(17-20)36aad1
3564.52
D(17-20)36aad3
3565.73
D(17-20)36aad2
UTM
3565
US 80
D(17-20)36cad
3565.48
D(17-20)36cad2
3561.75
D(17-20)36cad1
3564.85
D(17-20)36ddd
UTM
3570
D(17-20)36cdb
3567.81
D(17-20)36ddc
3568.30
3575
3580
D(17-20)36ddd
UTM
D(18-21)06bab
3585.52
3585
US 80
D(18-20)01aad
UTM
MW-20
3578.91
SW-03
8.5 (cfs)
SW-04
NM
D(18-21)06aca
3591.29
3590
SAN PEDRO RIVER
MW-17
3578.04
MW-18
3578.10
MW-08
3573.06
SEW-1
3578.12
D(18-21)06bcc2
3577.09
MW-19
3578.10
MW-10
DRY
MW-11
3590.70
MW-09
DRY
WASH 1
WASH 2
WASH 4
3595
MW-13
3595.18
MW-12
DRY
D(18-21)08bab
UTM
3600
MW-21
3601.55
WASH 3
WASH 5
MW-27
3603.22
MW-26
3602.71
3605
MW-22
3609.48
3610
APACHE NITROGEN
PRODUCTS, INC.
BOUNDRY
MW-24
3601.20
MW-14
3609.57
APACHE POWDER ROAD



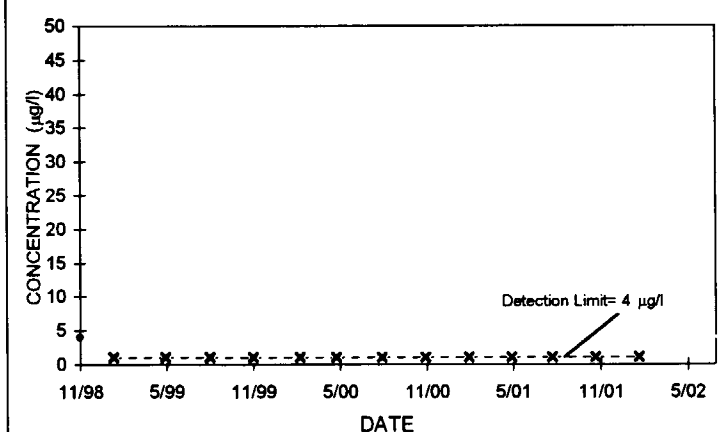
Shallow Aquifer Monitor Well MW-11



Shallow Aquifer Monitor Well MW-13



Shallow Aquifer Monitor Well MW-22



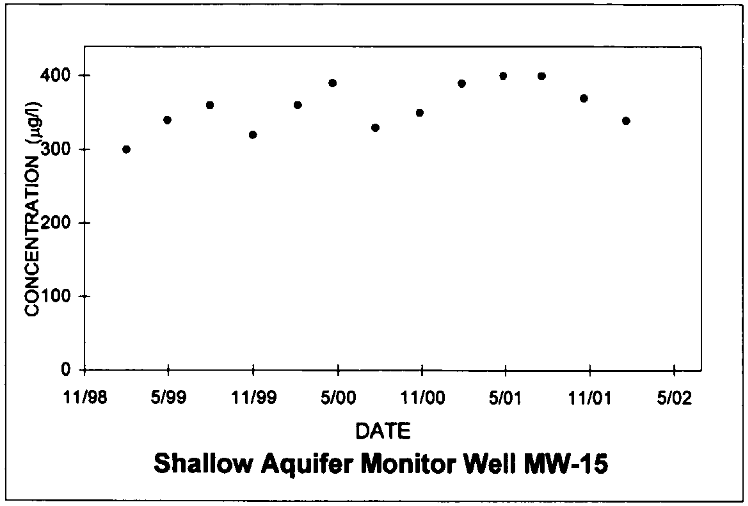
Shallow Aquifer Monitor Well MW-14

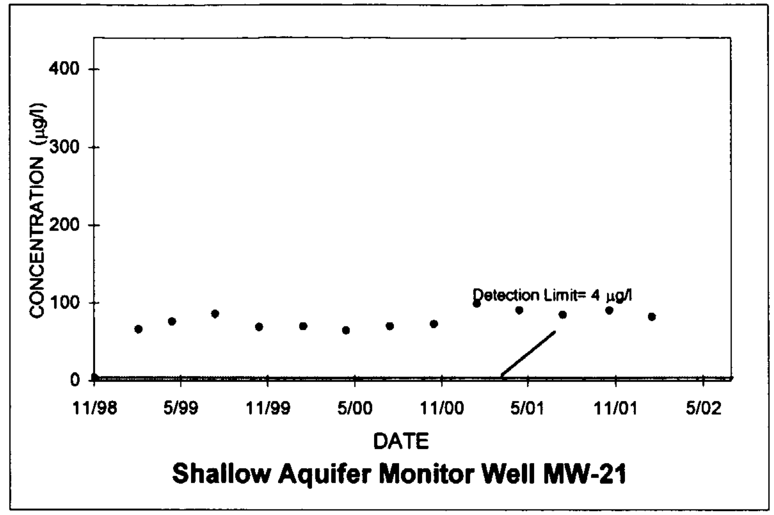
Note: see Figure 14D for explanation of abbreviations and symbols

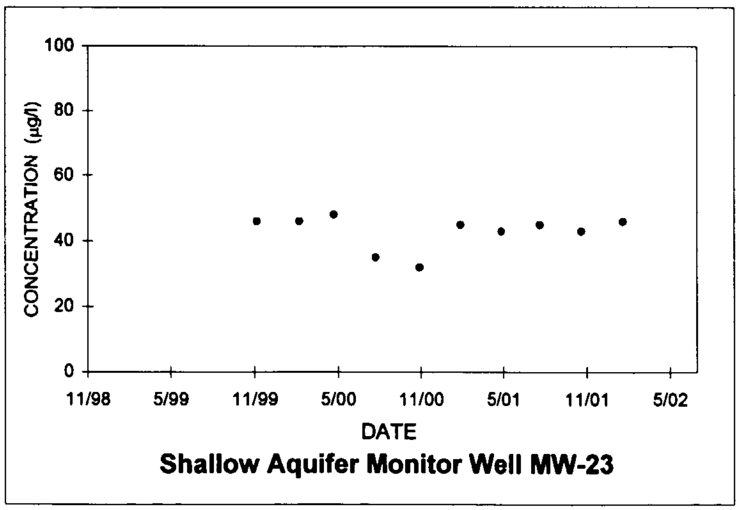
CH2MHILL

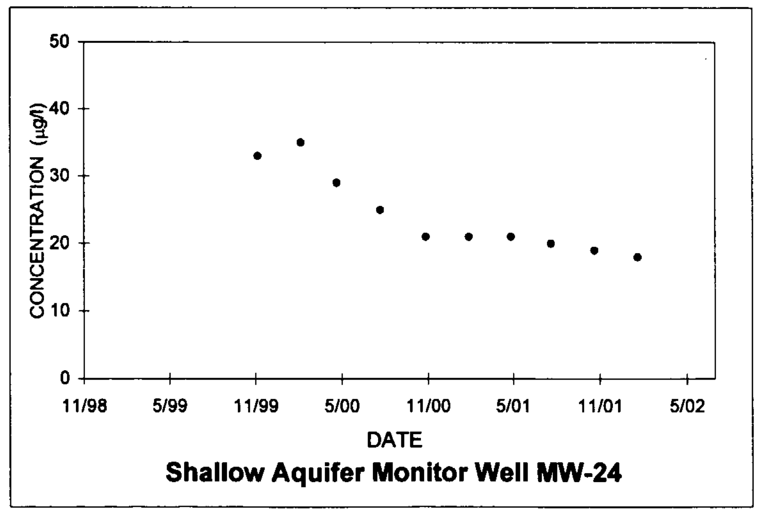
Source: Hargis & Associates, 2002

FIGURE 14A. WATER QUALITY HYDROGRAPHS FOR ClO_4 IN SHALLOW AQUIFER MONITOR WELLS MW-11, MW-13, MW-22 AND MW-14







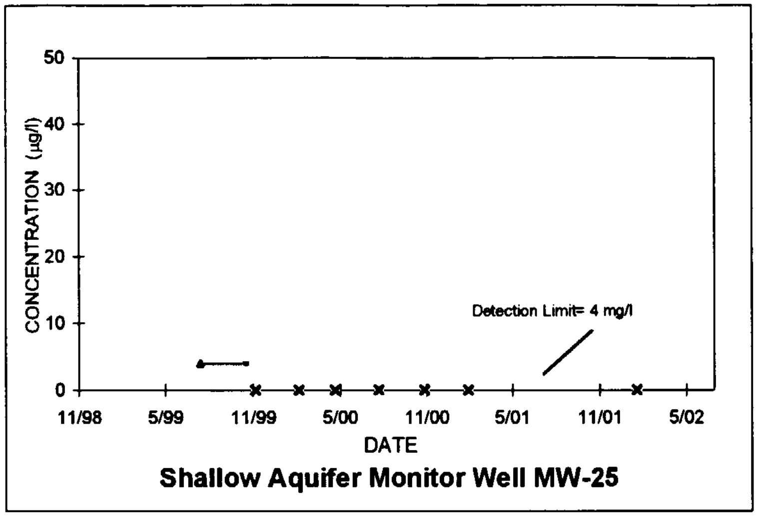


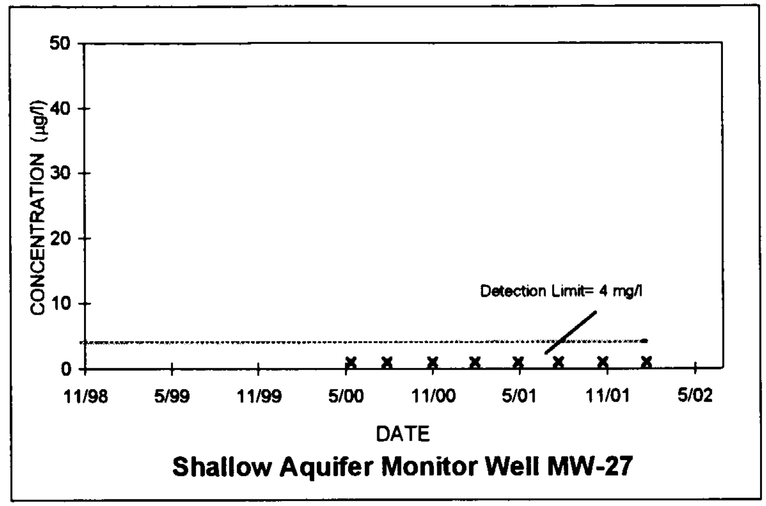
Note: see Figure 14D for explanation of abbreviations and symbols

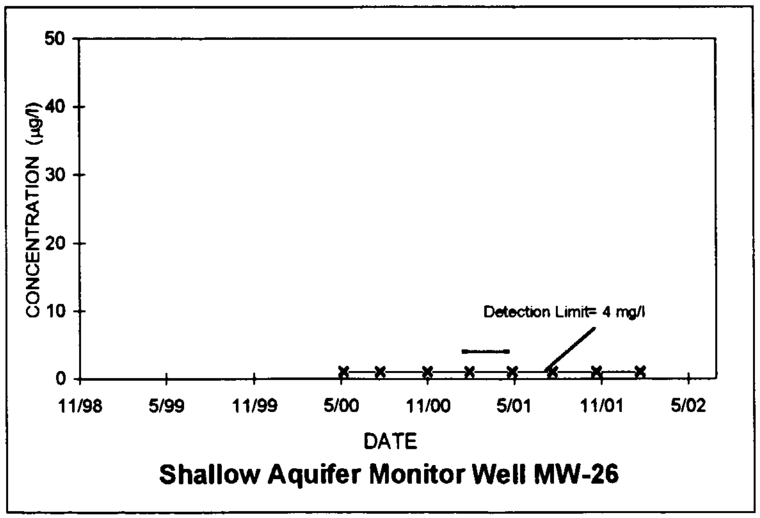
CH2MHILL

Source: Hargis & Associates, 2002

FIGURE 14B. WATER QUALITY HYDROGRAPHS FOR ClO_4 IN SHALLOW AQUIFER MONITOR WELLS MW-15, MW-21, MW-23, AND MW-24





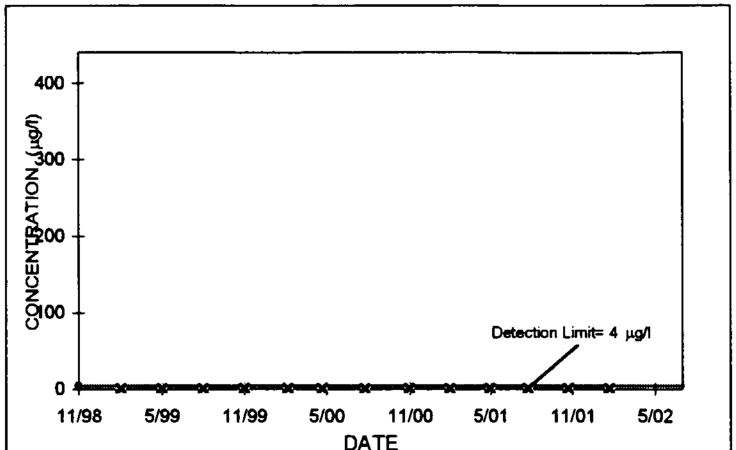


Note: see Figure 14D for explanation of abbreviations and symbols

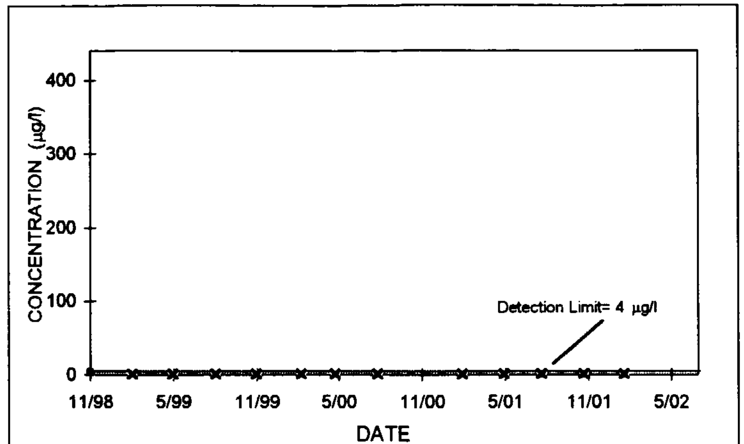
CH2MHILL

Source: Hargis & Associates, 2002

FIGURE 14C. WATER QUALITY HYDROGRAPHS FOR ClO_4 IN SHALLOW AQUIFER MONITOR WELLS MW-25. MW-27 AND MW-26



Shallow Aquifer Monitor Well MW-01



Shallow Aquifer Monitor Well MW-06

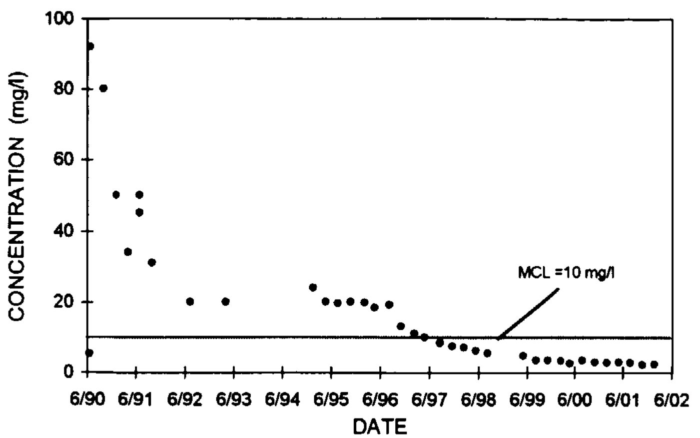
Notes:

MCL = Federal Maximum Contaminant Level
µg/l = Micrograms per liter
X = Not detected; Numerical value is less than the method detection limit
ClO_4 = Perchlorate
* = Value exceeds data range

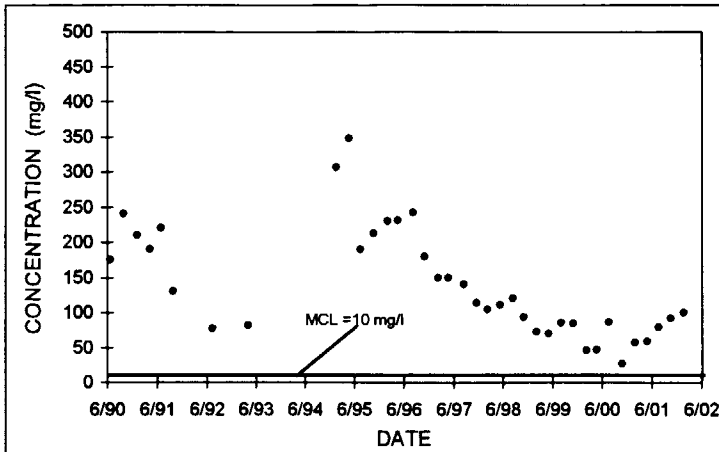
CH2MHILL

Source: Hargis & Associates, 2002

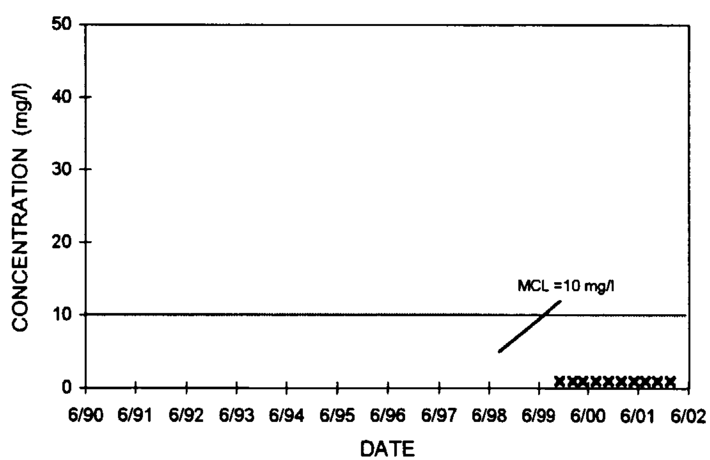
FIGURE 14D. WATER QUALITY HYDROGRAPHS FOR ClO_4 IN SHALLOW AQUIFER MONITOR WELLS MW-01, AND MW-06



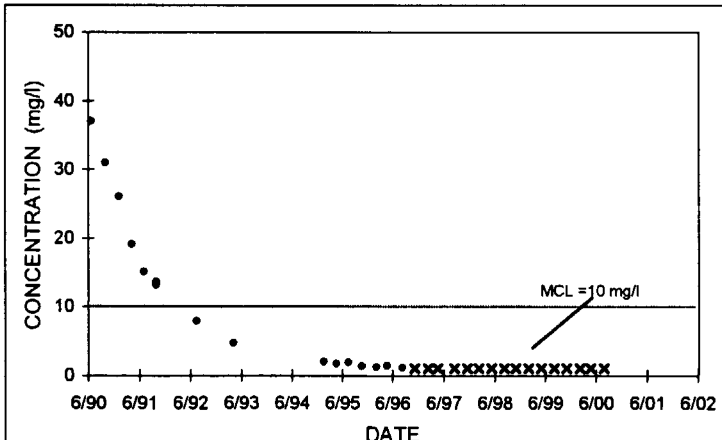
Shallow Aquifer Monitor Well MW-11



Shallow Aquifer Monitor Well MW-13



Shallow Aquifer Monitor Well MW-22



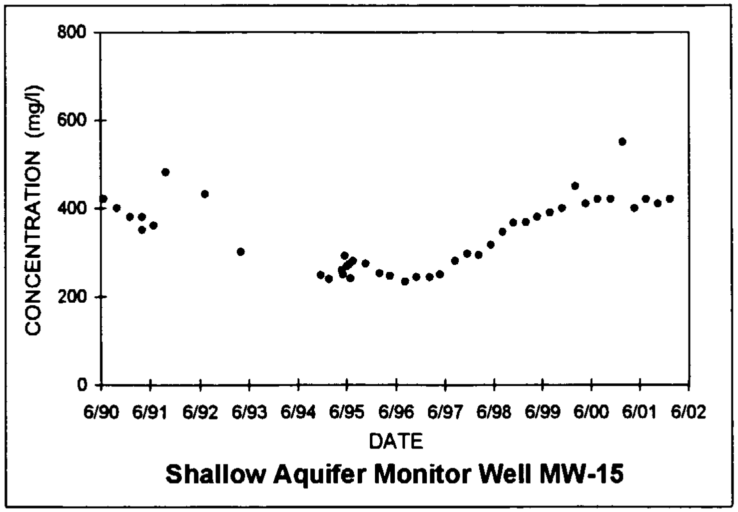
Shallow Aquifer Monitor Well MW-14

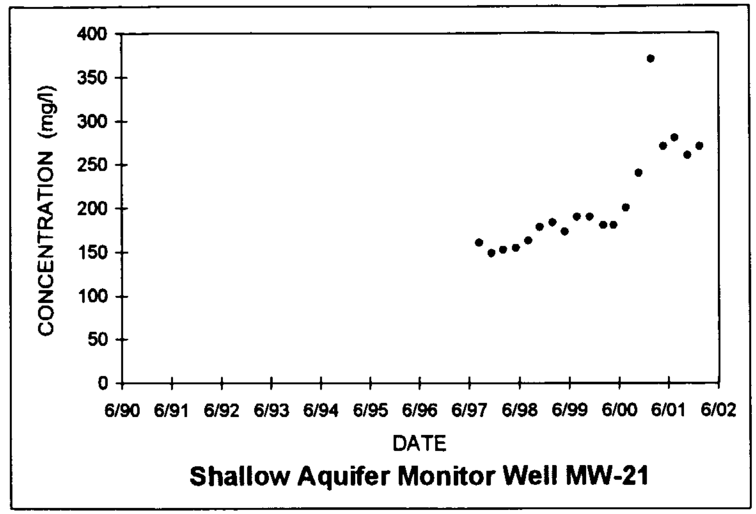
Note: see Figure 14H for explanation of abbreviations and symbols

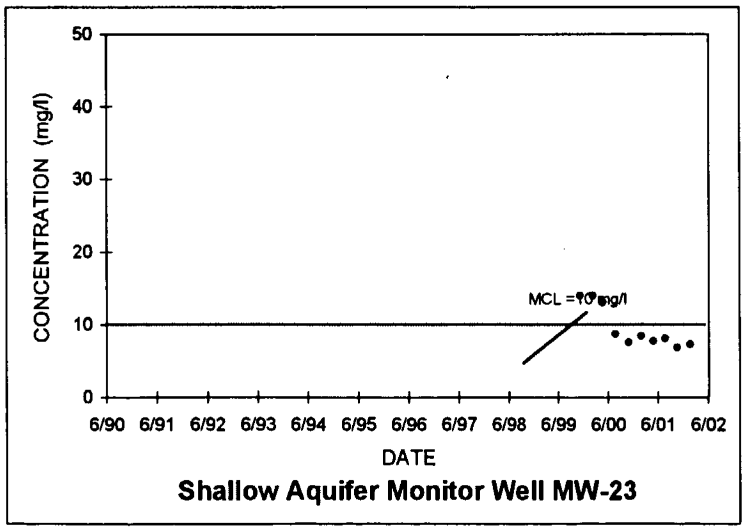
CH2MHILL

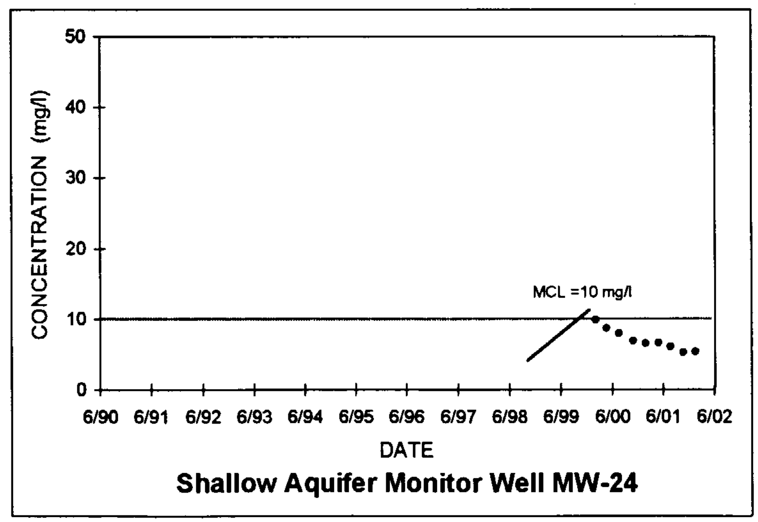
Source: Hargiss & Associates, 2002

FIGURE 14E. WATER QUALITY HYDROGRAPHS FOR NO_3-N IN SHALLOW AQUIFER MONITOR WELLS MW-08. MW-11. MW-13. AND MW-14







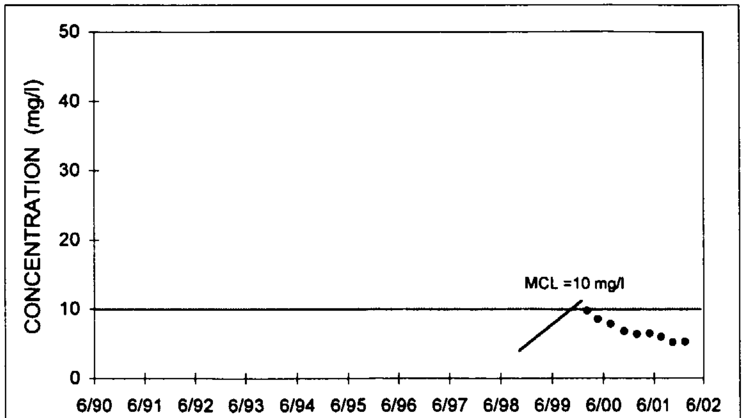


Note: see Figure 14H for explanation of abbreviations and symbols

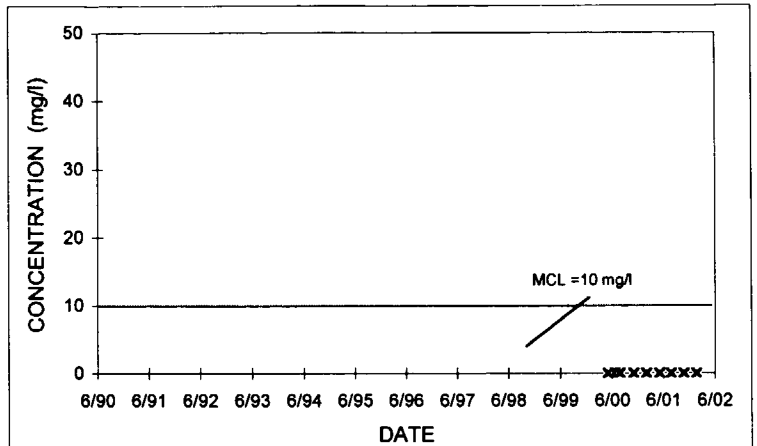
CH2MHILL

Source: Hargiss & Associates, 2002

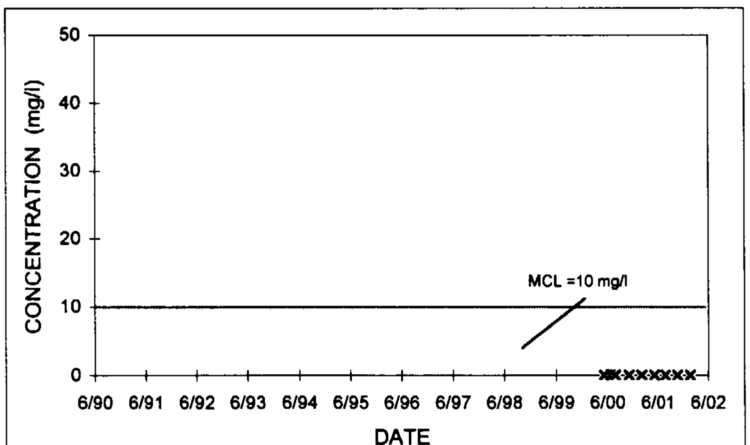
FIGURE 14F. WATER QUALITY HYDROGRAPHS FOR NO_3-N IN SHALLOW AQUIFER MONITOR WELLS MW-15, MW-21, MW-23, AND MW-24



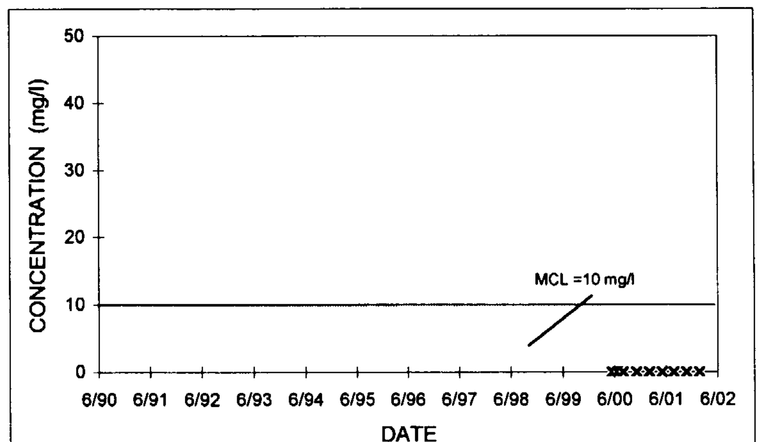
Shallow Aquifer Monitor Well MW-24



Shallow Aquifer Monitor Well MW-25



Shallow Aquifer Monitor Well MW-26



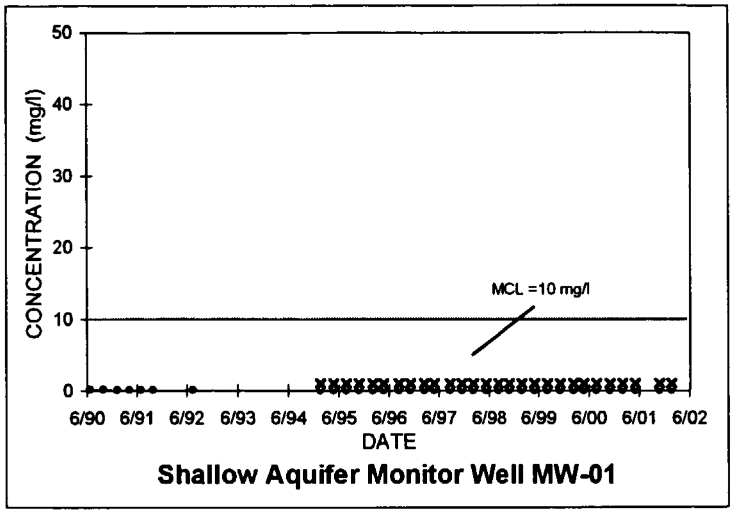
Shallow Aquifer Monitor Well MW-27

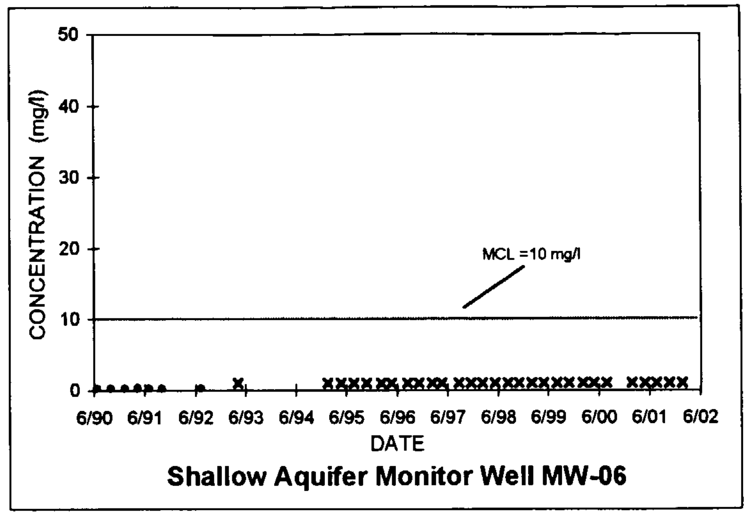
Note: see Figure 14H for explanation of abbreviations and symbols

CH2MHILL

Source: Hargiss & Associates, 2002

FIGURE 14G. WATER QUALITY HYDROGRAPHS FOR NO_3-N IN SHALLOW AQUIFER MONITOR WELLS MW-25. MW-26 AND MW-27





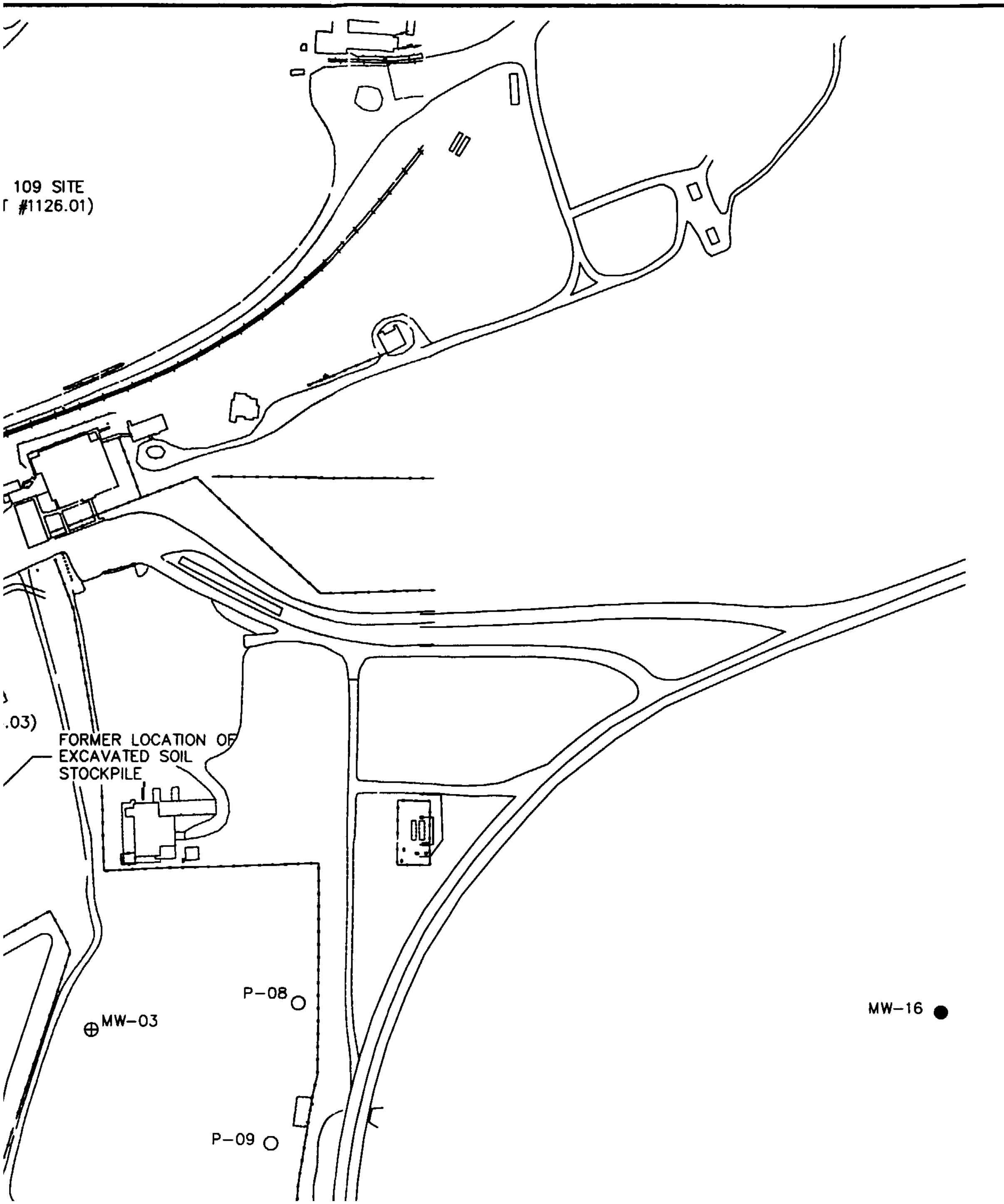
Notes:

DRY = Water level is below bottom of screen;
No formation water is present
ft msl = Feet above mean sea level
INS = Less than 1 foot of formation water is present;
Insufficient to collect representative sample
MCL = Federal Maximum Contaminant Level
mg/l = Milligrams per liter
X = Not detected; Numerical value is less
than the method detection limit
NO_3-N = Nitrate as nitrogen
* = Value exceeds data range

CH2MHILL

Source: Hargis & Associates, 2002

FIGURE 14H. WATER QUALITY HYDROGRAPHS FOR NO_3-N IN SHALLOW AQUIFER MONITOR WELLS MW-01 AND MW-06



EXPLANATION

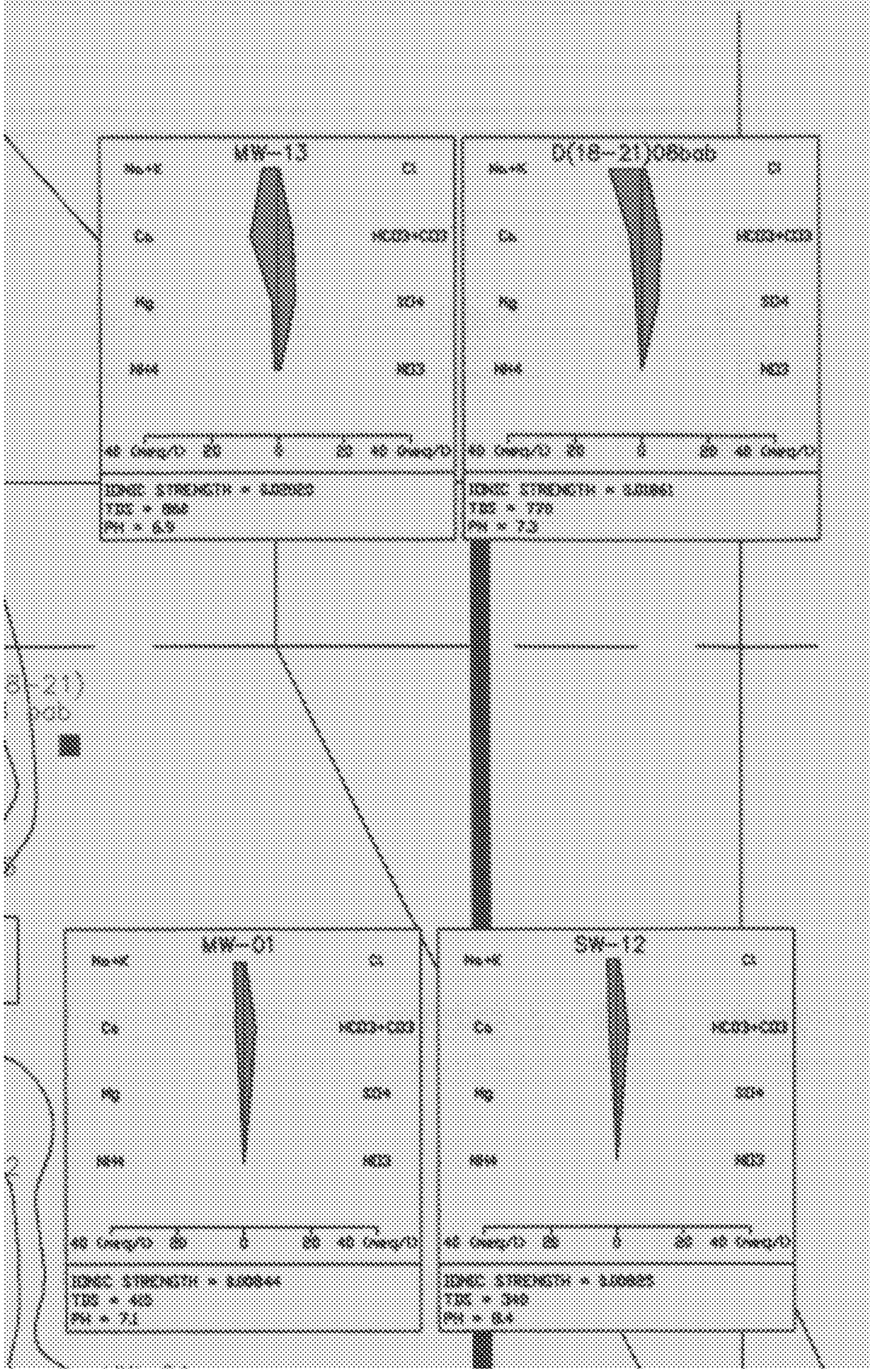
P-06 PERCHED ZONE PIEZOMETER LOCATION

MW-15 SHALLOW AQUIFER MONITOR WELL LOCATION

MW-02 PERCHED ZONE MONITOR WELL LOCATION

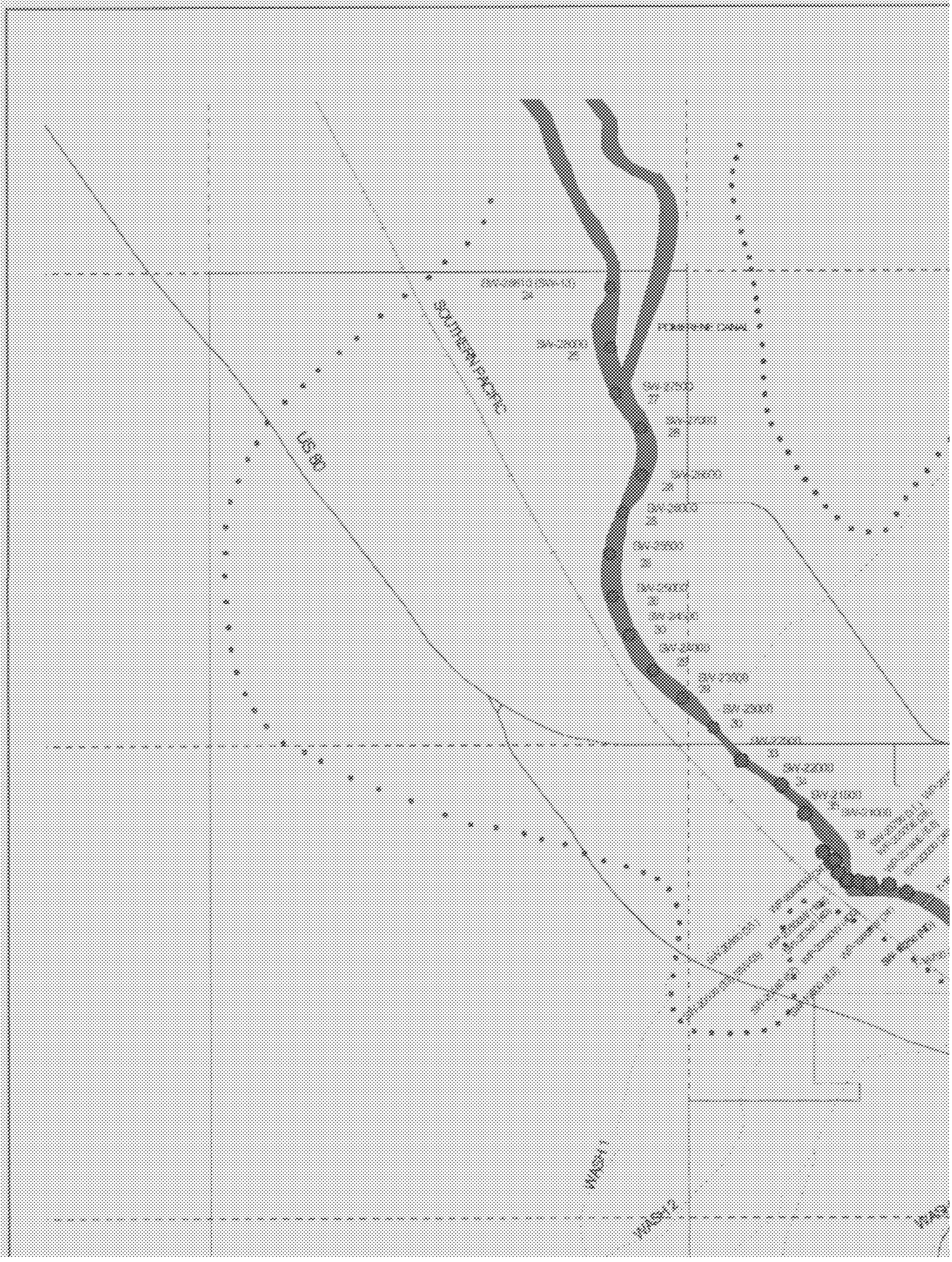
ANP-1 APACHE NITROGEN PRODUCTS, INC. DEEP AQUIFER WATER SUPPLY WELL

APPROXIMATE BOUNDARY OF SHALLOW AQUIFER



MW-14	SHALLOW AQUIFER MONITOR WELL
D(18-21) 08bab	SHALLOW AQUIFER PRIVATE WELL
MW-02	PERCHED ZONE MONITOR WELL
P-03	PERCHED ZONE PIEZOMETER
SW-12	SAN PEDRO RIVER SURFACE WATER MONITORING LOCATION
	APPROXIMATE BOUNDARY OF SHALLOW AQUIFER
meg/l	MILLIEQUIVALENTS PER LITER
MW-02	REFER TO STIFF DIAGRAM INSET

NOTE: BASED ON 2nd QUARTER 2000 SAMPLING ROUND DATA


SOUTHERN PACIFIC
US 50

APPENDIX A

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Hargis + Associates, Inc. 2001f. "Draft Characterization of Groundwater Systems in the Southern Area Apache Powder Superfund Site Cochise County, Arizona." April 27.

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APPENDIX B

Five-Year Review Site Inspection Checklist
Apache Powder Superfund Site

I. SITE INFORMATION

Site name: Apache Powder	**Date of inspection:** 5/8 & 9/2002
Location and Region: Conchise County, AZ, Region IX	**EPA ID:** 09C6
Agency, office, or company leading the five-year review: EPA Region IX	**Weather/temperature:** 90oF high, clear

Remedy Includes: (Check all that apply)

Landfill cover/containment
Access controls
Institutional controls
Ξ Groundwater pump and treatment (see below)
Surface water collection and treatment
Ξ Other Treatment Wetlands and offsite contaminant removal

Attachments: Ξ Inspection team roster attached Ξ Site map attached [in report]

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Dr. Gearheart (Name) Humbolt State University (Title) 5/8 2002 (Date)

Interviewed : at site Phone No. (707) 826-3135
Problems, suggestions; : Report attached

NOTE: All referenced attachments can be found in Five-Year Review Report.

2. **O&M staff** Leo Leonhart / Beth Ann Scully (Name) Hargis & Associates (Title) 5/8 - 9 /2002 (Date)

Interviewed at site / via electronic correspondence Phone No. . (520) 881-7300
Problems, suggestions
Report Attached

3.	**Local regulatory authorities and responsible agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply. Agency Arizona Department of Environmental Quality (ADEQ) Contact Bill Ellett (Name) — Project Manager / Hydrogeologist (Title) — 05/08/2002 (Date) — (520) 528-6714 (Phone No.) Problems; suggestions: Report attached Agency Arizona Department of Water Resources Contact Mason Bolitho (Name) — Manager – Water Quality Section (Title) — 05/08/2002 (Date) — (602) 417-2400 Ext. 7267 (Phone No.) Problems; suggestions: Report attached
4.	**Other interviews** (optional): Report attached.
	Bob Gearhart, Humbolt State University

III. ONSITE DOCUMENTS AND RECORDS VERIFIED (Check all that apply)			
1. **O&M Documents**			
Ξ O&M manual	Ξ: Readily available	Q Up to date – no, in progress	
Ξ As-built drawings	Ξ Readily available	Q Up to date – no, in progress	
Ξ Maintenance logs	Ξ Readily available	Ξ Up to date - yes	
Remarks			
2. **Site-Specific Health and Safety Plan**	Ξ: Readily available	Ξ Up to date	
Ξ: Contingency plan/emergency response plan	Ξ Readily available	Q Up to date	
Remarks			
3. **O&M and OSHA Training Records**	Ξ Readily available	Q Up to date	Q N/A
Remarks OSHA Training Records not reviewed, O&M records readily available			

4. **Permits and Service Agreements**

Q Air discharge permit — Q Readily available — Q Up to date — : N/A

Ξ Effluent discharge — Q Readily available — Q Up to date — : N/A

Q Waste disposal, POTW — Q Readily available — Q Up to date — : N/A

Q Other permits ______________ — Q Readily available — Q Up to date — : N/A

Remarks Effluent discharge currently operating under a conditional agreement from the EPA pending full-scale start-up and discharge under NPDES; NPDES permit not yet approved; Many other permits for the current operating facility exist not related to management as an EPA Superfund Site, therefore they were not reviewed.

5. **Gas Generation Records** — Readily available — Up to date — Ξ : N/A

Remarks ______________

6. **Settlement Monument Records** — Ξ Readily available — Ξ Up to date — : N/A

Remarks Survey data taken from off four corners of site. Groundwater wells surveyed in. Comprehensive groundwater well survey data available.

7. **Groundwater Monitoring Records** — Ξ Readily available — Ξ Up to date — N/A

Remarks Comprehensive library on-site

8. **Leachate Extraction Records** — Readily available — Up to date — Ξ: N/A

Remarks ______________

9. **Discharge Compliance Records**

: Air — : Readily available — Up to date — Ξ N/A

: Water (effluent) — : Readily available — Up to date — Ξ N/A

Remarks Full-scale start-up of NARS and therefore constant groundwater discharge has not been initiated at the site. Compliance records documenting EPA approved conditional limited scale start-up were available.

10. **Daily Access/Security Logs** — Ξ : Readily available — Ξ Up to date

Remarks Visitor's sign-in logs.

1. **O&M Organization**

State in-house — Contractor for State

PRP in-house — Contractor for PRP

Other Not discussed during site inspection

2.	**O&M Cost Records**			
	Readily available		Up to date	
	Funding mechanism/agreement in place		Ξ NA	
	Original O&M cost estimate________________			Breakdown attached
	Total annual cost by year for review period if available			
	Date	Date	Total cost	
From________		To________	________	Breakdown attached
	Date	Date	Total cost	
From________		To________	________	Breakdown attached
	Date	Date	Total cost	

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons:

____

____

____

____

____

V. ACCESS AND INSTITUTIONAL CONTROLS Applicable

A. Fencing

1. **Fencing** Ξ Location shown on site map Ξ: Gates secured N/A

Remarks As discussed in report, fencing was in good condition surrounding active site areas. There was no fencing between the San Pedro River and the site area.

____

B. Other Access Restrictions

1. **Signs and other security measures** Ξ Location shown on site map N/A

Remarks Good condition within active areas and wetlands. Trespass along the San Pedro River appeared common, indicated by the domestic debris along the river.

C. Institutional Controls

1. **Implementation and enforcement**

	Yes	No	Ξ: N/A
Site conditions imply ICs not properly implemented	Yes	No	Ξ: N/A
Site conditions imply ICs not being fully enforced	Yes	No	Ξ: N/A

Type of monitoring (e.g., self-reporting, drive by) ______

Frequency ______

Responsible party/agency ______

Contact ______ ______ ______ ______
Name Title Date Phone No.

Reporting is up-to-date	: Yes	No	Ξ N/A
Reports are verified by the lead agency	Yes	No	Ξ N/A
Specific requirements in deed or decision documents have been met	: Yes	No	Ξ N/A
Violations have been reported	Yes	No	Ξ N/A

Other problems or suggestions: Report attached

There are no formal institutional controls pertaining to the remedial actions at this site under EPA jurisdiction.

2. **Adequacy** : ICs are adequate ICs are inadequate Ξ N/A

Remarks ______

D. General

1. **Vandalism/trespassing** Ξ Location shown on site map Ξ: No vandalism evident

Remarks Discussed in report; in the vicinity of the San Pedro River only

2. **Land use changes onsite** Ξ N/A

Remarks Not apparent

3. **Land use changes offsite** Ξ N/A

Remarks Increasing residential development nearby

A. Roads Ξ: Applicable

1. **Roads** Ξ Location shown on site map Ξ Roads adequate N/A

Remarks Within the site operations area and off-site access roads were in good condition

B. Other Site Conditions

Remarks Complete discussion of site inspection provided in Section 6.3 of Five-Year Review Report (attached).

VII. LANDFILL COVERS Applicable

A. Landfill Surface

1. **Settlement** (Low spots) Location shown on site map Settlement not evident
Areal extent____________ Depth____________
Remarks ____________

2. **Cracks** Location shown on site map Cracking not evident
Lengths ____________ Widths____________ Depth____________
Remarks ____________

3. **Erosion** Location shown on site map Erosion not evident
Areal extent____________ Depth____________
Remarks ____________

4. **Holes** Location shown on site map Holes not evident
Areal extent____________ Depth____________
Remarks ____________

5. **Vegetative Cover** Grass Cover properly established No signs of stress
Trees/Shrubs (indicate size and locations on a diagram)
Remarks ____________

6. **Alternative Cover** (armored rock, concrete, etc.) N/A
Remarks ____________

7. **Bulges** Location shown on site map Bulges not evident
Areal extent____________ Height____________
Remarks ____________

8.	**Wet Area/Water Damage**	Wet areas/water damage not evident		
	Wet areas	Location shown on site map	Areal extent__________	
	Ponding	Location shown on site map	Areal extent__________	
	Seeps	Location shown on site map	Areal extent__________	
	Soft subgrade	Location shown on site map	Areal extent__________	
	Remarks ______________________________			
9.	**Slope Instability**	Slides	Location shown on site map	No evidence of slope instability
	Areal extent________________			
	Remarks ______________________________			
B. Benches		Applicable	N/A	
	(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)			
1.	**Flows Bypass Bench**	Location shown on site map	N/A or okay	
	Remarks ______________________________			
2.	**Bench Breached**	Location shown on site map	N/A or okay	
	Remarks ______________________________			
3.	Bench Overtopped	Location shown on site map	N/A or okay	
	Remarks ______________________________			
C. Letdown Channels		Applicable	N/A	
	(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)			
1.	**Settlement**	Location shown on site map	No evidence of settlement	
	Areal extent________________	Depth________________		
	Remarks ______________________________			
2.	**Material Degradation**	Location shown on site map	No evidence of degradation	
	Material type________________	Areal extent________________		
	Remarks ______________________________			

3.	**Erosion**	Location shown on site map	No evidence of erosion		
	Areal extent______		Depth______		
	Remarks______				
4.	**Undercutting**	Location shown on site map	No evidence of undercutting		
	Areal extent______		Depth______		
	Remarks______				
5.	**Obstruction**	Type______	No obstruction		
	Q Location shown on site map		Areal extent______		
	Size______				
	Remarks______				
6.	**Excessive Vegetative Growth**	Type ______			
	No evidence of excessive growth				
	Vegetation in channels does not obstruct flow				
	Location shown on site map		Areal extent______		
	Remarks______				
D. Cover Penetrations		Applicable	Ξ N/A		
1.	**Gas Vents**	Active	Passive		
	Properly secured/located	Functioning	Routinely sampled	Good condition	
	Evidence of leakage at penetration				
	Remarks______				
2.	**Gas Monitoring Probes**				
	Properly secured/located	Functioning	Routinely sampled	Good condition	
	Evidence of leakage at penetration				
	Remarks______				
3.	**Monitoring Wells** (within surface area of landfill)				
	Properly secured/located	Functioning	Routinely sampled	Good condition	
	Evidence of leakage at penetration				
	Remarks______				
4.	**Leachate Extraction Wells**				
	Properly secured/located	Functioning	Routinely sampled	Good condition	
	Evidence of leakage at penetration		Needs O&M	N/A	
	Remarks______				

5.	**Settlement Monuments**	Located	Routinely surveyed	N/A
	Remarks____			
E. Gas Collection and Treatment		Applicable	N/A	
1.	**Gas Treatment Facilities**			
	Flaring	Thermal destruction	Collection for reuse	
	Good condition	Needs O&M		
	Remarks____			
2.	**Gas Collection Wells, Manifolds and Piping**			
	Good condition	Needs O&M		
	Remarks____			
3.	**Gas Treatment Facilities** (e.g., gas monitoring of adjacent homes or buildings)			
	Good condition	Needs O&M	N/A	
	Remarks____			
F. Cover Drainage Layer		Applicable	N/A	
1.	**Outlet Pipes Inspected**	Functioning	N/A	
	Remarks____			
2.	**Outlet Rock Inspected**	Functioning	N/A	
	Remarks____			
G. Detention/Sedimentation Ponds		Applicable	N/A	
1.	**Siltation** Areal extent__________	Depth__________		N/A
	Siltation not evident			
	Remarks____			
2.	**Erosion** Areal extent__________	Depth__________		
	Erosion not evident			
	Remarks____			
3.	**Outlet Works**	Functioning	N/A	
	Remarks____			
4.	**Dam**	Functioning	N/A	
	Remarks____			

H. Retaining Walls Applicable Ξ N/A	
1.	**Deformations** Location shown on site map Deformation not evident Horizontal displacement_____ Vertical displacement_____ Rotational displacement_____ Remarks _____
2.	Degradation Location shown on site map Degradation not evident Remarks _____
I. Perimeter Ditches/Off-Site Discharge Applicable Ξ N/A	
1.	**Siltation** Location shown on site map : Siltation not evident Areal extent_____ Depth_____ Remarks _____
2.	**Vegetative Growth** Location shown on site map Ξ N/A : Vegetation does not impede flow Areal extent_____ Type_____ Remarks _____
3.	**Erosion** Location shown on site map Erosion not evident Areal extent_____ Depth_____ Remarks _____
4.	**Discharge Structure** Functioning Ξ N/A Remarks _____

VIII. VERTICAL BARRIER WALLS Ξ: N/A

1. **Settlement** Location shown on site map Settlement not evident
Areal extent______ Depth______
Remarks ______

2. **Performance Monitoring** Type of monitoring______
Q Performance not monitored
Frequency______ Q Evidence of breaching
Head differential______
Remarks ______

IX. GROUNDWATER/SURFACE WATER REMEDIES Ξ: Applicable

A. Groundwater Extraction Wells, Pumps, and Pipelines Ξ: Applicable

1. **Pumps, Wellhead Plumbing, and Electrical**
Ξ: Good condition Q: All required wells located Needs O&M N/A
Remarks Observed above-grade piping was in good condition; the extraction / pumping system was not in operation at the time of the site visit as full-scale start up has not been initiated

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
Ξ: Good condition Needs O&M
Remarks Observed above-grade piping was in good condition; the extraction / pumping system was not in operation at the time of the site visit as full-scale start up has not been initiated.

3. **Spare Parts and Equipment**
Ξ: Readily available Good condition Requires upgrade Needs to be provided
Remarks According to Pamela Bielke, site environmental manager, materials are readily available.

B. Surface Water Collection Structures, Pumps, and Pipelines Ξ Applicable

1. **Collection Structures, Pumps, and Electrical**
Ξ Good condition Needs O&M
Remarks Temporary well points near the San Pedro River were in good condition. Pertaining to the wetlands cells, overall they were in good condition and appeared capable of maintaining capacity during a rain storm event.

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
Good condition Needs O&M Ξ NA
Remarks ______

3.	**Spare Parts and Equipment** Readily available Good condition Requires upgrade Needs to be provided Ξ NA Remarks ________________
C. Treatment System Ξ: Applicable	
1.	**Treatment Train** (Check components that apply) Metals removal Oil/water separation Bioremediation Air stripping Carbon adsorbers Filters________________ Ξ Additive (e.g., chelation agent, flocculent) Carbon source – currently sodium acetate Others ________________ Ξ Good condition Needs O&M Ξ Sampling ports properly marked and functional Ξ Sampling/maintenance log displayed and up to date Ξ Equipment properly identified Quantity of groundwater treated annually NA Quantity of surface water treated annually NA Remarks Full-scale startup is not yet initiated for the NARS, at the time of the site visit preparations for this later in 2002 were underway
2.	**Electrical Enclosures and Panels** (properly rated and functional) N/A Good condition Ξ Needs O&M Remarks At the time of the site visit preparations were underway for the installation of solar panels for the a recirculation pump within the wetlands cells. Extraction well electrical enclosure in good working condition according to interview but was not viewed as it was not in operation at the time of the site visit.
3.	**Tanks, Vaults, Storage Vessels** Ξ N/A Remarks ________________
4.	**Discharge Structure and Appurtenances** Ξ Good condition Needs O&M Remarks Planned full-scale startup NARS discharge point has never been in operation but appeared in good working condition.
5.	**Treatment Building(s) – support building** N/A Ξ Good condition (especially roof and doorways) Needs repair Chemicals and equipment properly stored Remarks The only structure within the NARS housed safety and repair equipment. It appeared to be in good condition. However, the carbon source (sodium acetate) was stored outside adjacent to the wetlands on pallets covered with tarp.

6.	Monitoring Wells (pump and treatment remedy) Properly secured/locked Functioning Ξ Routinely sampled Good condition All required wells located Needs O&M N/A Remarks Extraction well SEW-1 was not in operation at the time of the site inspection and therefore not observed. All observed monitoring wells were in good condition routinely sampled.

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

Ξ Properly secured/locked   Ξ Functioning   Ξ Routinely sampled   Ξ Good condition

Not attempted All required wells located   Needs O&M

Remarks Monitored natural attenuation is a remedy under consideration during which time all wells are routinely sampled as a part of the regular groundwater monitoring program. All observed wells appeared in good condition.

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The NARS was constructed in 1997 to treat extracted shallow groundwater from the northern area, extraction well SEW-1, for discharge to Wash 3. The wetland has not yet entered full-scale operations. A detailed analyses is provided in the report.

B.	Adequacy of O&M
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. Minimal O&M problems have occurred with the piping and electrical system servicing effluent and influent to the NARS. The wetlands treatment cells have had O&M problems resulting in delayed full-scale startup. Remedies have been implemented and it is expected that full-scale startup will begin during 2002.

C.	Early Indicators of Potential Remedy Failure
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of .unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. During limited-scale startup many unexpected O&M activities occurred, delaying full-scale startup. These include caterpillar (pest) infestation and exceeding concentrations of e.coli and fecal coliform in the ANA treatment cell. Remedies are planned and some implemented to allow for full-scale startup in 2002. It is expected that these remedies will allow for an effective treatment system. Further discussion is provided in the Report.

D.	Opportunities for Optimization
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Optimization may not be assessed until full-scale startup is initiated.

EPA Superfund Site Visit - 5 Year Review

ATTENDEES: May 8-10, 2002:
Andria Benner, EPA Region 9;
Tina Girard, CH2M Hill SFO;
Sean Hogan, EPA Region 9;
Pamela Beilke, ANP; Leo Leanhart, Hargis & Associates

May 8, 2002:
Bill Elliot, ADEQ;
Bob Gearheart, Humbolt State University;
Phil Whitmore, CH2M Hill PHX;
Mason Bolitho, ADWR

FROM: Tina Girard

DATE: May 15, 2002

May 8, 2002

Northern Area Remediation System Tour – Media Component 2A:

Wetlands:
-Carbon source added to wetland, was previously molasses, anticipate adding carbon source until a successful (no caterpillars) season of cattails has occurred; Started adding molasses in mid-July 2001.
-Residence time for water in wetland is ideally 8 to 30 days when full operation commences
-Plan to complete a new O&M plan that details the new flow system, previously only 1 inlet/outlet point now there will be multiple points
-Erosion on some slopes of certain cells, hydroseeded these areas yet there was no horizontal contours. Plan to irrigate with wetlands water for vegetation establishment on slopes, potential concern: continued erosion of banks during high intensity storms; HSU Staff evaluated options for erosion control and recommended hydroseeding only (Pamela)

Discharge Discussions, San Pedro River Walk:

-Temporarily at small scale discharged to Wash 3 at 30-60 gpm, water never reached >200 ft from discharge point at surface during discharge
-Dry wells near GT15 / Wash 3
-Plan to cycle water in wetlands until E. coli and fecal coliform problem solved
-Plan to discharge wetlands water into Wash 3 - will create a perched zone <20 ft bgs, cannot discharge at full-scale startup until in compliance under NPDES
-Viewed the final planned discharge point (piping,etc…); never utilized; all piping in good condition and in tact
-Evaluated recharging shallow zone via injection into wells, looked at logs of various wells, decided solving fecal coliform & E.coli problem is the best route and continue with plans to discharge to Wash 3 on the surface
-Along San Pedro River – evidence of trespass (backpacks, litter), adjacent to water white crystallized staining on moist soil

-At Wash 3 discharge point appears to be surface flow only as there is very little water flowing, i.e. not a discharge point for shallow acquifer
-Green algae present in water which requires no sunlight
-River hotspot = 360 ppm Nitrate-Nitrogen, potential sources identified as Wash 5 or 6, or discharge from shallow zone at this point as flow increases; EC very high at hotspot; closest monitoring point = 5WP20180
-Planning the advancement of soil borings near river hotspot to further define problem

Meeting - Conference Room - Wetlands Discharge

-To decrease concentrations of E.coli and fecal coliform in discharge Bob recommended a slow sand filter (0.5 gpm) placed between the Parshal flume and discharge point, requiring little maintenance; the biofilm on the sand polishes the water; sand filter 300-400 ft^2, Requires seasonal scraping; works via adsorption and bacteria die when they loose their host (water); used commonly in wastewater treatment; only effective in approx 2 log reduction; well sorted sand is the best; is there sand available on property?; Fecal coliform reduced in approximately 48 hours; turbidity is not an issue as the sand filter has the ability to decrease this as well
-Solar pump to be installed the week of May 13, 2002 for recirculation of water in cells, max 50 gpm, 100 ft total head; Recirculation of water throughout wetland necessary, otherwise nitrate-nitrogen concentrations increase
-In 1997 DWR instituted notification process of all actions permitted under them to be conducted within 1 mile of a Superfund Site, notifies permitee of potential hazards associated with ANP
-HSU researched perchlorate breakdown as nitrate-nitrogen microorganisms have the ability to also breakdown perchlorate but have a preference for nitrate, particularly at high concentrations
-Eco-risk & MNA will not be included in 5-year review but set up as an addendum with a definitive timeline for review at a later date
-The source of contamination in Wash 5 may be Dynagel pond and Pond 7
-Source of river hotspot uncertain, possibly channel from northern area shallow aquifer discharging at this point, thought to be the 'caboose' of the plume (i.e. no current source)

Action Items:
-For comparison, EPA would like a sample of influent tested for E.coli and coliform (have never tested before)
-Research database (DWR or ADEQ) for data on NPDES discharge parameters from San Pedro River for background comparison
-Hargis to research appropriate sand size and availability (on site) for slow sand filter
-HSU to perform lab testing of effectiveness of sand in filtering water (samples taken from wetland and sent to HSU)
-Is there flexibility with NPDES sampling, currently requires daily sampling, no composite samples
-Continue adding Sodium Acetate
-New O&M Plan to include redesign of flow

-EPA plans to take split samples next quarter of river hotspot (and maybe other locations) for low level perchlorate testing in Richmond, CA lab; concerned with growing research/publicity surrounding perchlorate

May 9, 2002

Tour of entire facility - State CD & EPA managed areas

-All RCRA areas are satisfied and closed for the state; the APP permit needs to be issued prior to CD closing, this permit will include closure plans for outstanding areas.
-Q: Is Dynagel pond responsible for river surface hotspot as this area was the location of production until the 1980s?

State CD Areas:
-'Tree Line' ditch near UST filling station – no visual signs of contamination on surface
-Currently waste water from carwash and clearing go to evaporative basin near tree lined pond
-Large lime basin used during current operations, will be closed under APP; located near Piezometer P-1
-Tank 174 was a former plastic tank that was replaced with a double wall steel tank; tank holds wastewater, state was concerned with secondary containment, STRONG NH3 odor from an unknown source; ponded water attributed to 'clean-out' and 'needs to be pumped out', sampled soil borings to the east – ND, located near piezometer P-1
-Brine concentrator was installed and is in operation under the state, the residue is non-hazardous and is disposed of offsite.
-Near P-1 and tank 174 is 3 anhydrous ammonia AST
-Ponds 1A & 1B –adequate fencing, Mesquite trees approx. 30% coverage, mild metal waste throughout the ponds on the surface.
-Pond 2A – Fencing adequate, white powder residue evident on pond surface, (lime used for softening the water – possibly this is the residue), no vegetation established, deep soil borings in this area, piping still in place but not in use.
-Borrow Pit – Investigated under the state and was the former area used to store apricot pits used in packing explosives
-Landfill –closed without a cap – an area of large debris, vegetation present
-OBOD Area: only part of site with restricted land use, ANP filed a Voluntary Environmental Mitigation Use Restriction on this area upon closure; very little vegetation coverage (10-15%), area is in a valley, drainage area. Wash 3 crosses the OBOD area (Photo 11); no fencing in this area
-The old 'Powder Line' is a series of buildings formerly used in the manufacturing of explosives; is a State area; was inspected and cleared by Fire Arms & Tobacco personnel for UXO; Photo 12
-Laundry Area (state) where they used to wash the clothing of laborers at the Plant; Washing machine water was discharged into natural wash/pond downgradient of a stream. Strong vegetation; building still remaining; investigation performed in this area; no fencing; adjacent to currently operating prill plant
-Photo 20 LUST site near Prill Plant; closed and excavated under state; paved area

-Photo 19 old railroad line running to currently operating prill plant; stops just after laundry area/UST and stops about 100ft from prill plant; previous unloading areas not evident; extensive number of control boxes along old rail line.
-Carbamite area sloping down a hillside, closed under APP, salvage yard nearby in flats containing numerous very large storage vessels probably from ANP's Molinos Plant in New Mexico, purchased in the 1980's.
-Pond 9 - part of Wash 6 drainage received water from detonation cord plant; approx. 60% vegetation throughout 9 series ponds; no fencing
-Recycle yard in active area of site - large salvage area with debris separated

Media Component 1: Perched Groundwater Aquifer
-MW-7 and Piezometers near Wash 6 are dry
-Active fertilizer tank (#101) east of white waste area

Media Component 4: White Waste and Drum Storage Area:
-Photo 2 East of white waste area; white waste area was on a steep hillslope where it appears that a pully system was utilized for manufacturing.
-Drum storage area - in wash below hills (opposite side of hill of white waste area), no drums evident, sparse vegetation, residue of metal components (drum lids) and ceramic packing materials evident. Photos 3 and 4

Media Component 5: Wash 3 Area:
-In 1993 262 Drums and DNT contaminated soil above Pond 5A were removed, pre-ROD; black plastic liner remain in the area from soil sampling and excavation activities which provide a good marker for future reference; no fencing; approx. 30-40% vegetation cover
-All 'A' ponds drain to 'B' ponds which were used for overflow during high intensity storms

Media Component 7: Other Drums
-Old bunkers related to the 'powder line' adjacent to Wash 5, the abandoned railroad and warehouse 244; Pond 8 leads to Wash 5 and is overgrown with vegetation (60-70%) (Photos 13 -15); Adjacent to Pond 8 is an old building, the former Hod Repait, containing hods used for the transport of nitroglcerin on the railroad; Removed drums from Wash 5 beneath the Pond and erosion increased as the drums were providing slope stability; In this area of the old railroad there are many old switchboxes associated with the railroad still in place; Warehouse 244: removed DNT drums that were stored on pallets; No fencing in this area

TNT Contaminated Area:
-TNT Area - source thought to be from pre-APN era on site when TNT products were 'recycled' by different owners as TNT has never been manufactured onsite by APN; area was exposed during a high intensity storm and discovered during routine site inspection of drainage areas following storm; No residual stained areas observed; TNT area is on a hillside, downgradient is a natural arroyo, acting as a drainage retention basin due to the grading on the adjacent road; TNT was excavated with plastic shovels into plastic buckets and transported by hand over the hill to Pond 4B where the material was burned; Severe erosion on the hillslope of Pond 4B; Photos 5 and 6 TNT area; Burning area, Pond 4B Photos 7 and 8; New tank constructed near pond 4B, possibly for the storage of NH3NO3.

-Photo 9 from Pond 4B to TNT area to Drum storage area to White waste, undulating landscape.

Media Component 3: Inactive Ponds (4A, 4B, 5A, 6A, 7, 8 and Dynagel Pond)
-Photo 10: Pond 5B to 5A berm and mountains in distance; no fencing in this area
-Above Pond 5B ceramic remnants of piping, possibly debris from the demolition of the former nitroglycerin facilities
-Pond 6A & 6B: former temporary storage area (TOSA) ;no fencing, approx. 25% vegetation coverage
-Dynagel Pond - adjacent to a natural drainage system (seasonal creek) leading to Wash 5; sparse (15%) vegetation cover; no fencing; adjacent to this pond is a building structure that operated until the 1980's, a large 'new' looking tank remains; no investigations ever performed on the tank; near this area is the railroad & switchboxes. Photos 16 and 17
-Pond 7/ Prill Plant: Prill wash full of old piping that leads to Pond 7

OTHER:
-Most ponds were constructed in natural ephermal drainages which were utilized during production in conjunction with the natural washes for material transport.
-An EPCRA community study was performed in 1997 & 1999 due to violations of air discharge
-ANP is in close contact with the local community and realtors in the area and sends out quarterly information on operations and environmental activities

APPENDIX C

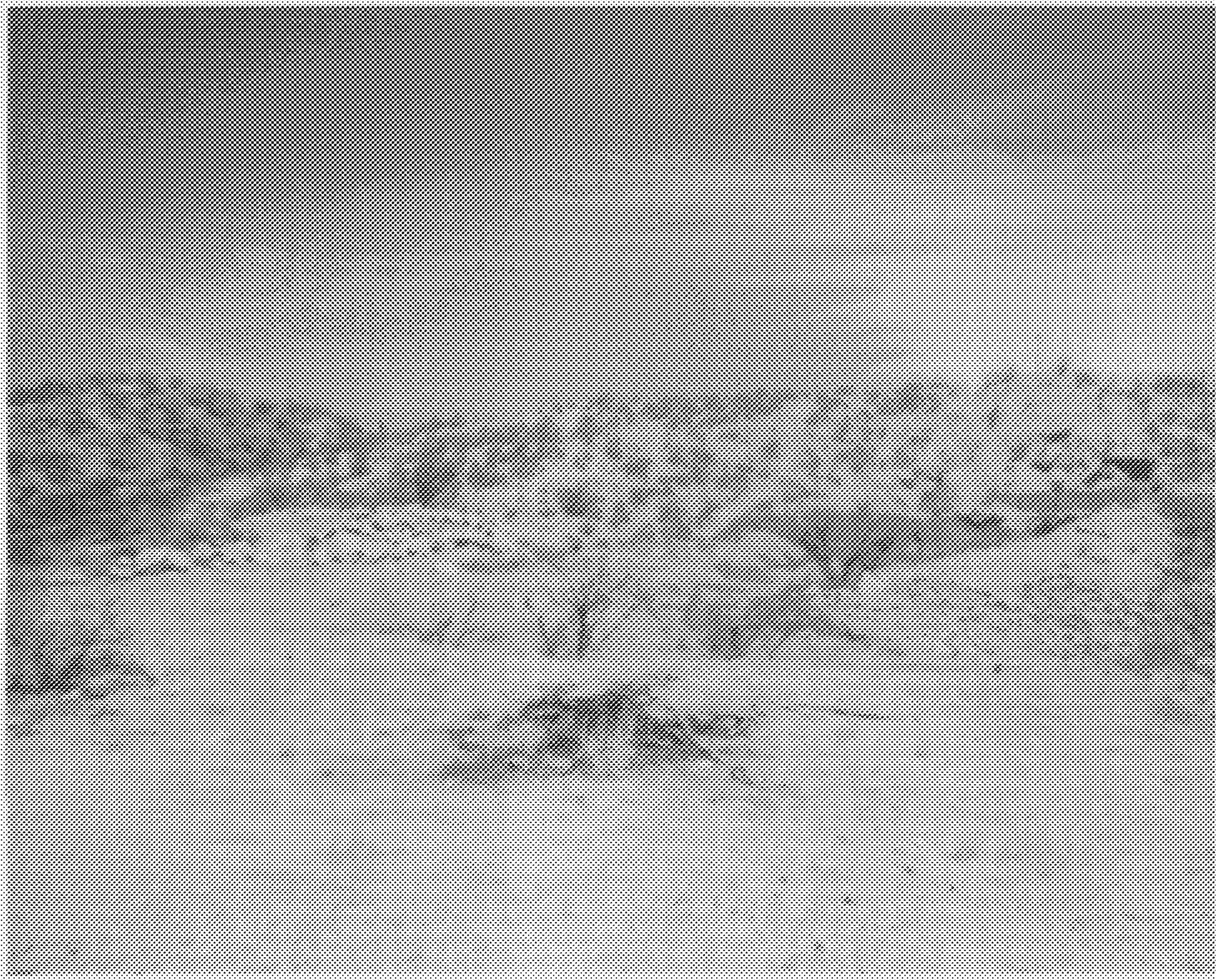


Photo 1: Media Component 4 – White Waste Storage Area, lookin

Photo 3: Media Component 4 – Drum Storage Area, looking

Photo 5: Media Component 8 – TNT Removal area, lookin

Photo 7: Media Component 8 – TNT Pre-Treatment area, lo

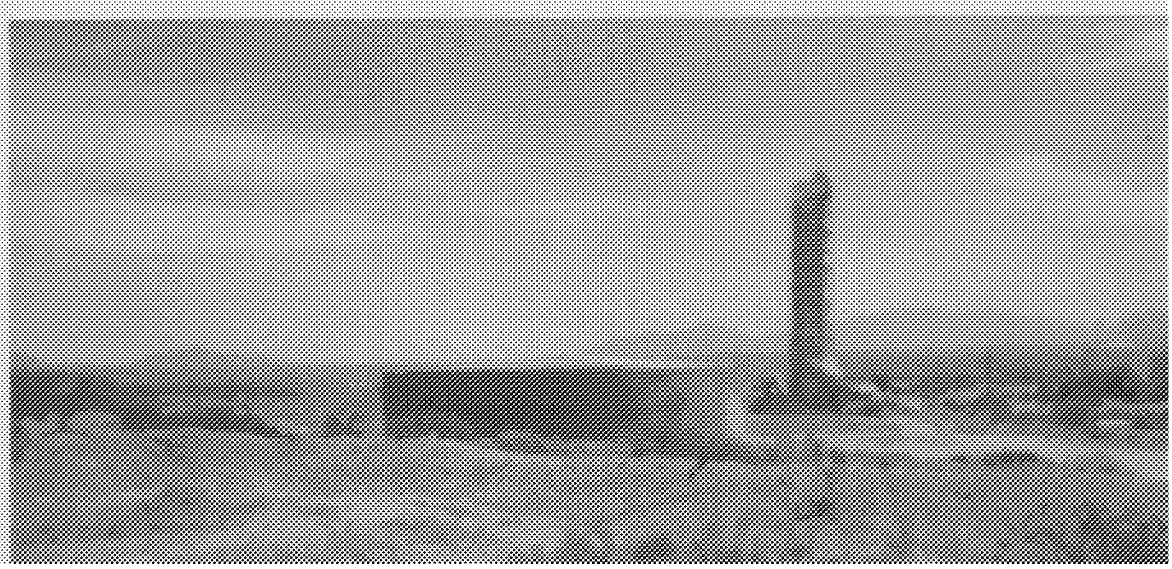


Photo 9: Pond 4B looking south towards TNT Removal A
to Drum Storage Area to White Waste Storage Area

Photo 11: OBOD Area (State Regulated) and Wash 3, lookin

Photo 13: Media Component 3 – Pond 8 and Wash 5, looking s

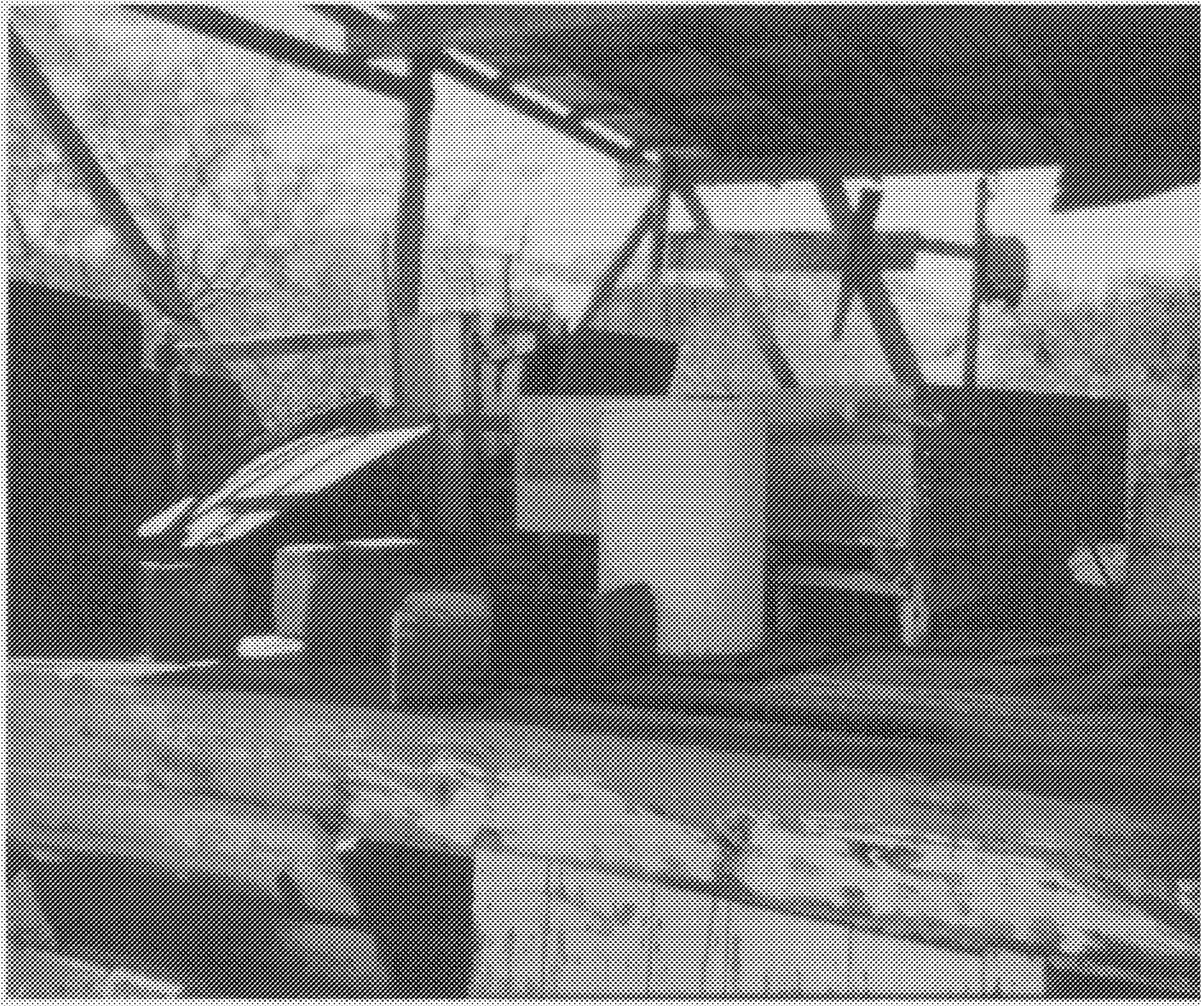


Photo 15: Storage Facility adjacent to Pond 8, looking n

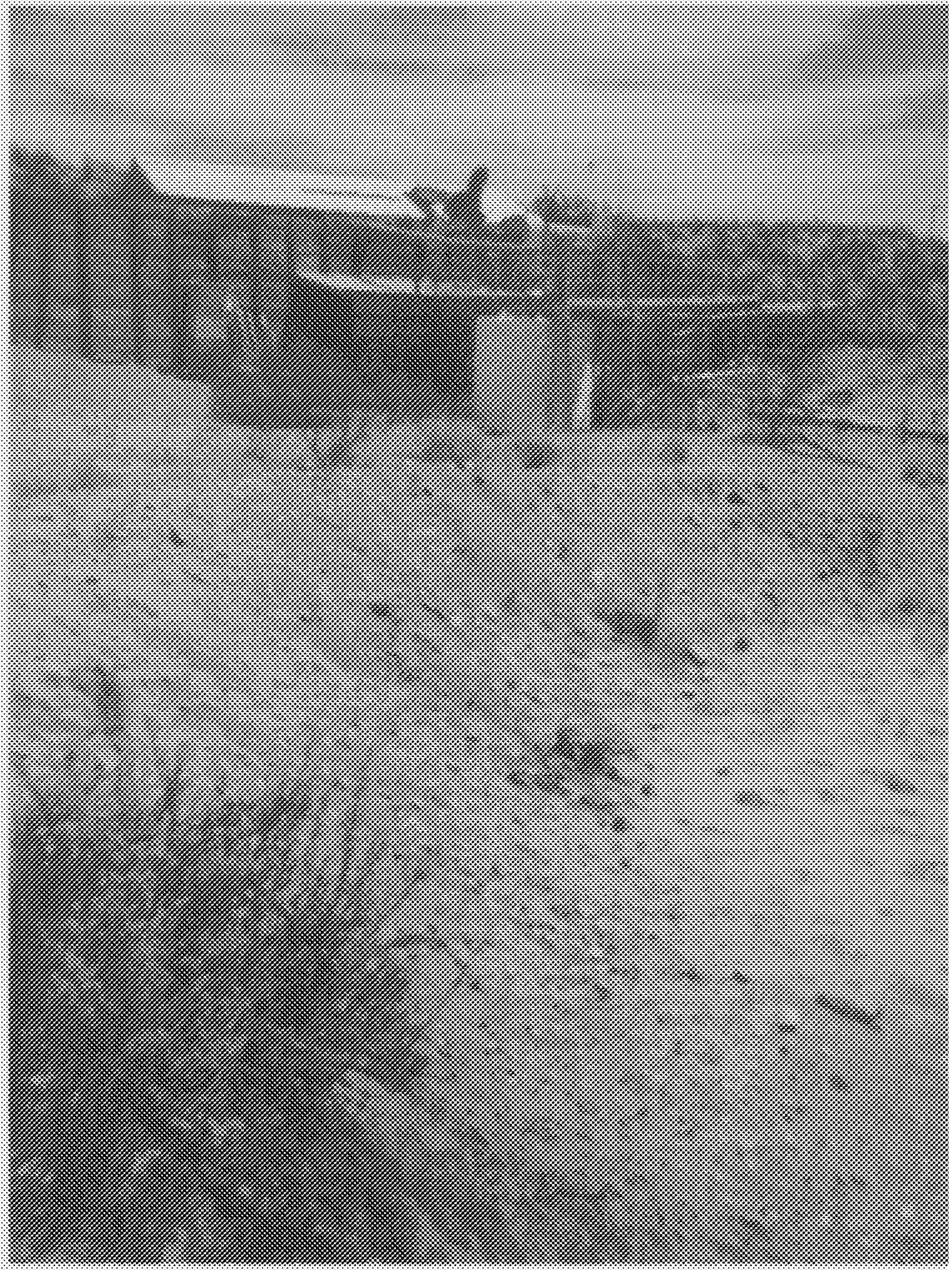


Photo 17: Media Component 3 – Dynagel Pond and adjacent former operating facility

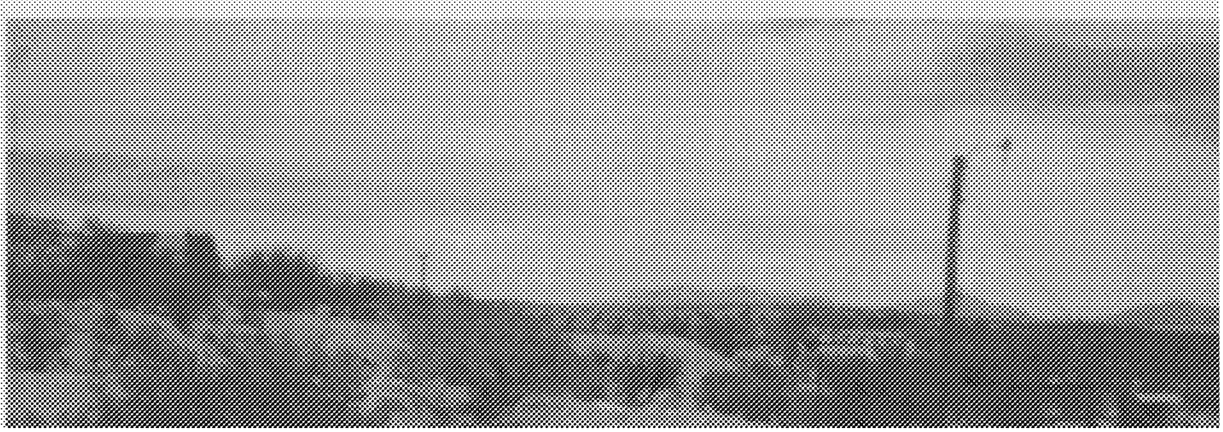


Photo 19: Former Laundry Area (State Regulated), lookin

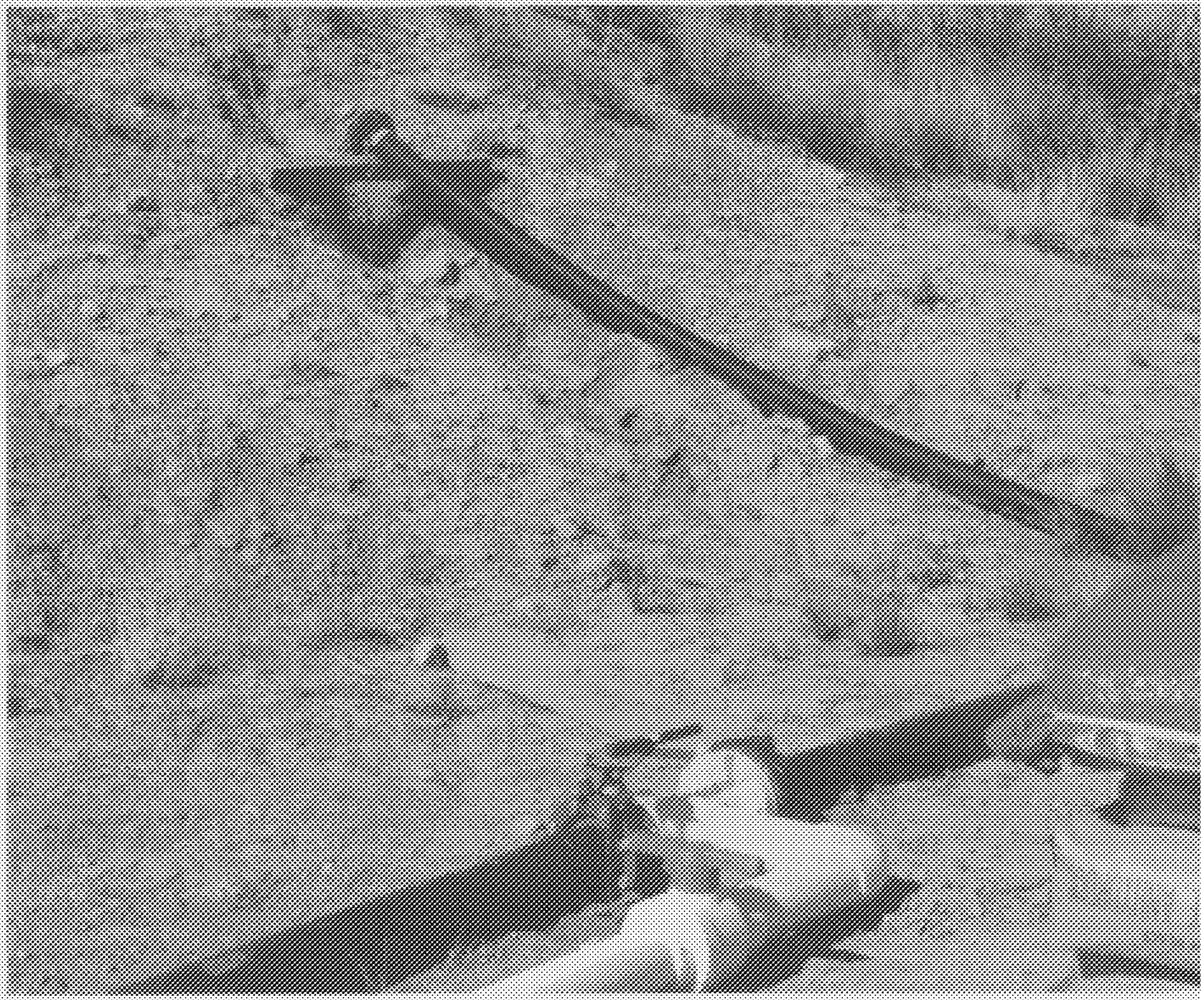


Photo 21: Media Component 2A – Southeast corner of the PD
influent overflow piping and carbon source storage

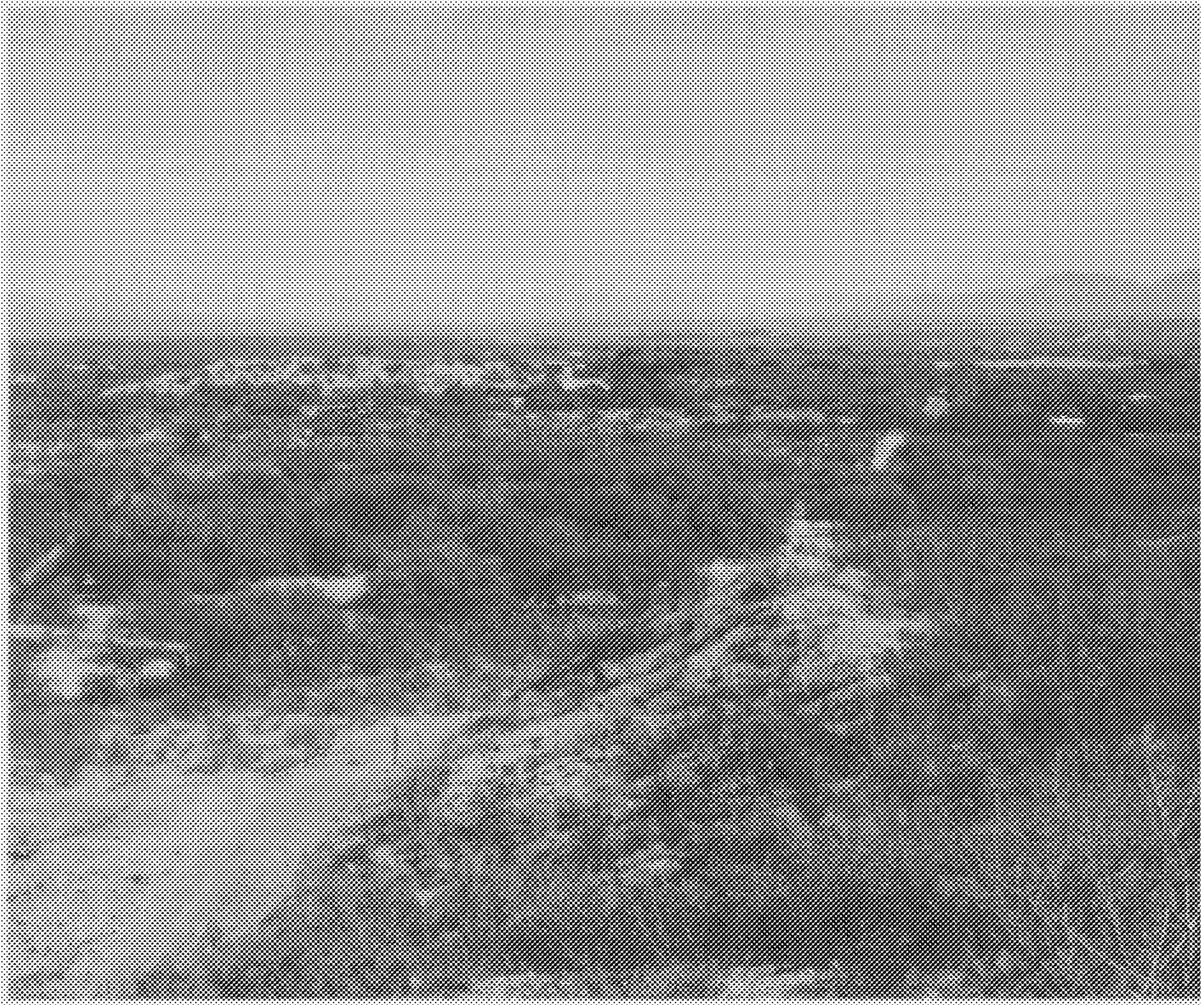
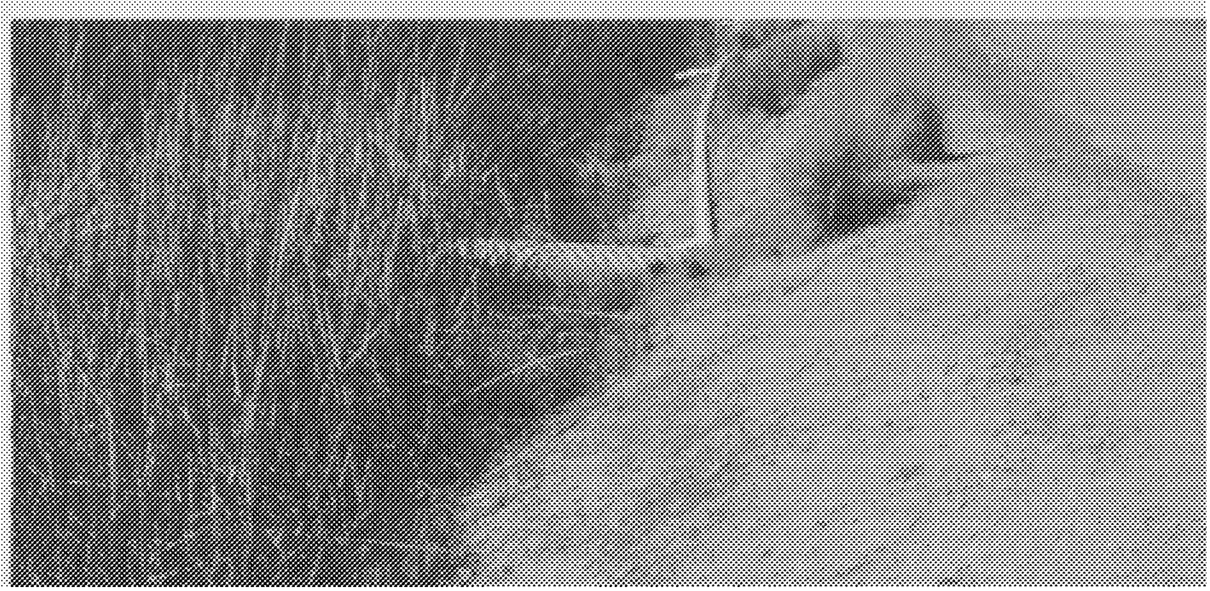


Photo 23: Media Component 2A – Looking northeast from NARS



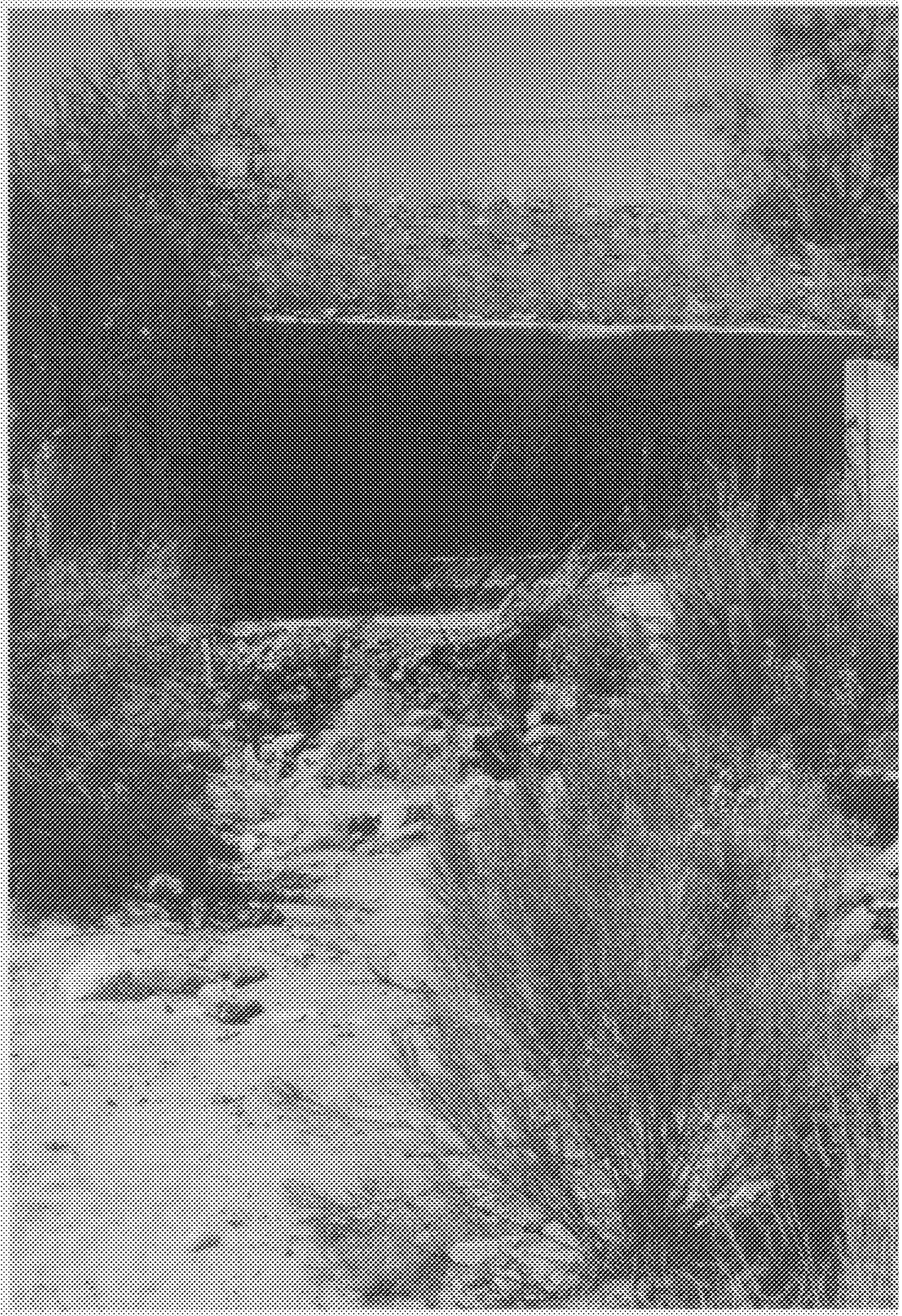


Photo 25: Wash 3, downgradient from the alternate discharge poi
San Pedro River, looking north, northeast

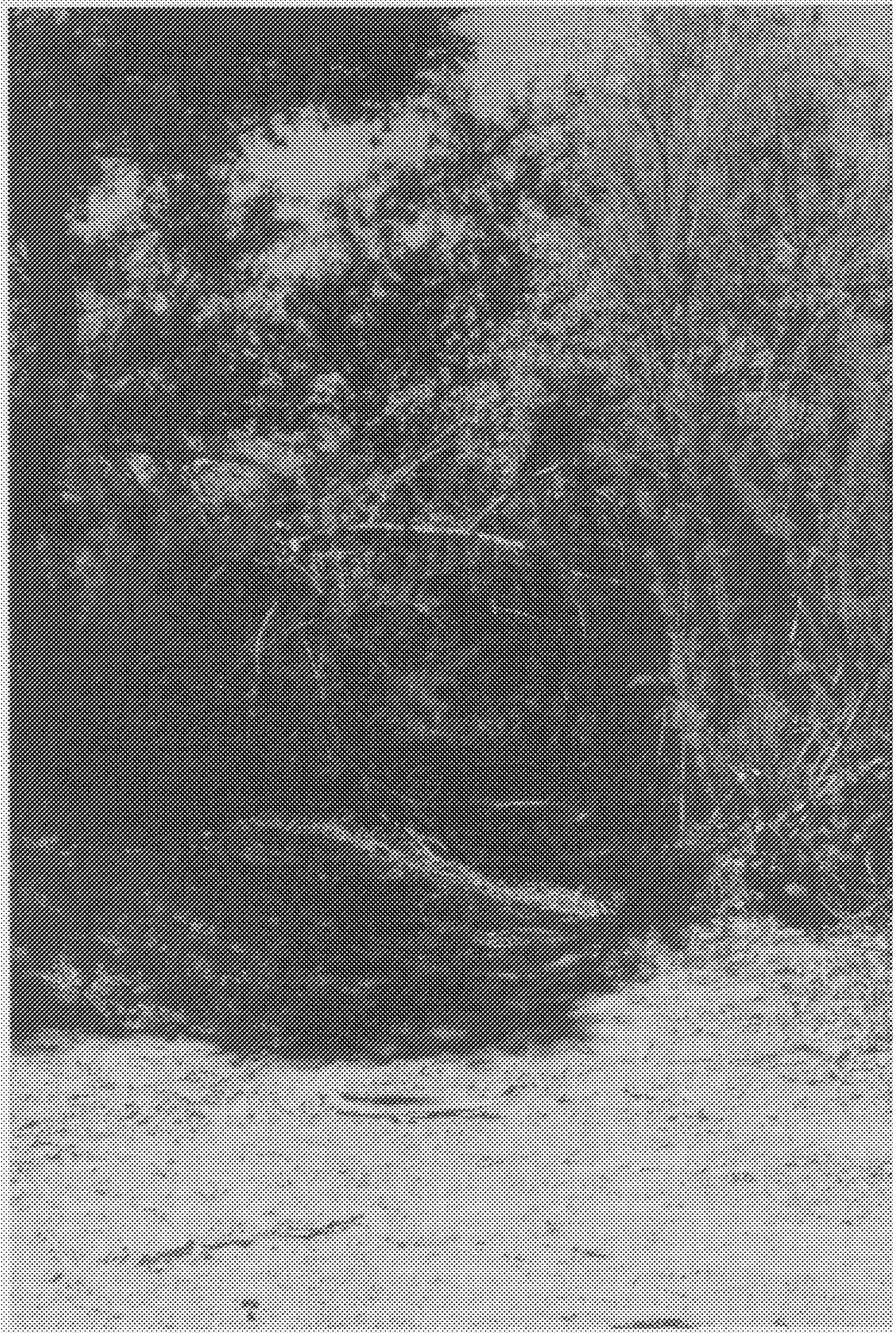


Photo 27: Wash 3 discharge point to San Pedro River, looki